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ENTERED AT POST OFFICE, NEW YORK, AS SECOND CLASS MATTER.

Parallel Instantaneous Grip Vise.

The sectional and perspective views represent this vise, which is designed to have the same power as the screw vise, with the advantage of having the work gripped or released with less than half a turn of the handle. For instance, a piece of work an inch thick can be released from the jaws and an eight-inch piece substituted and tightly gripped with less than one revolution of handle, and by a continuous motion of the right hand. Fig. 1 shows the parts out of gear.

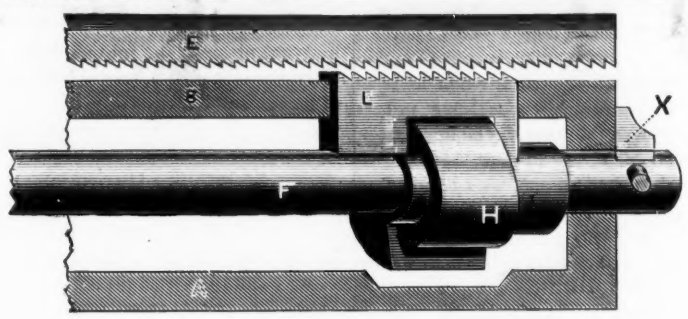


FIG. 1.

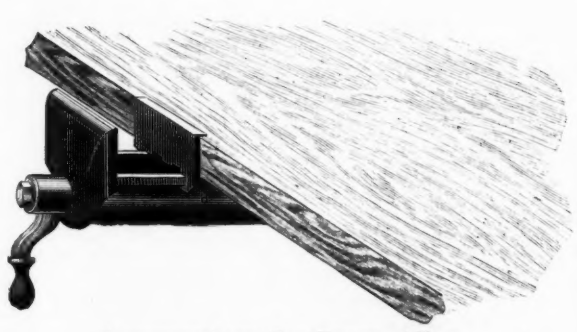
Fig. 2 represents the movable parts detached; Fig. 3 shows position of cam *H*, and block *L* when loose jaw is free to be slid to or from still jaw; Fig. 4 shows position of cam *H* and block *L* when all parts are in gear.

The letters refer: *F* to shaft on which is secured at its front outer end hand-lever *G*, and near its opposite end scroll cam *H*. On this cam slides block *L*, which is provided with flanges that embrace the cam, and also a series of teeth which are adapted to fit into corresponding teeth in plate *E*, which is secured to cap piece *C*.

By manipulating the hand-lever *G*, the spindle *F*, with cam *H*, can be caused to move block *L* into or out of contact with tooth plate *E*. When the block *L* is not in contact with tooth plate *E*, the loose jaw can be slid to the width required to hold the work, then by turning the handle *G* in direction of arrow, Fig. 2, the cam *H* will raise block *L* into contact with tooth-plate *E*, and owing to the spiral or scroll shape of cam will draw loose jaw *B* closer to the jaw *K*, and consequently secure the work firmly between the jaws.

In order to limit throw of handle *G*, and consequent movement of spindle *F*, a stop *X* is placed on the end of bar *B*. The construction of block *L* and plate *E*, is such that when manipulating hand lever *G* the teeth always go into gear, allowing hand-lever to be as in Fig. 4, when grip commences. The vise is made with parts interchangeable and of the best stock, all working parts being steel.

These vises are manufactured solely by T. C. Massey, Batavia, Ill.



CARPENTERS' AND CAR BUILDERS' VISE.

FIG. 3.

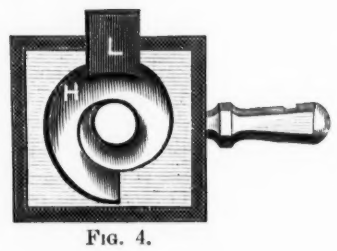


FIG. 4.

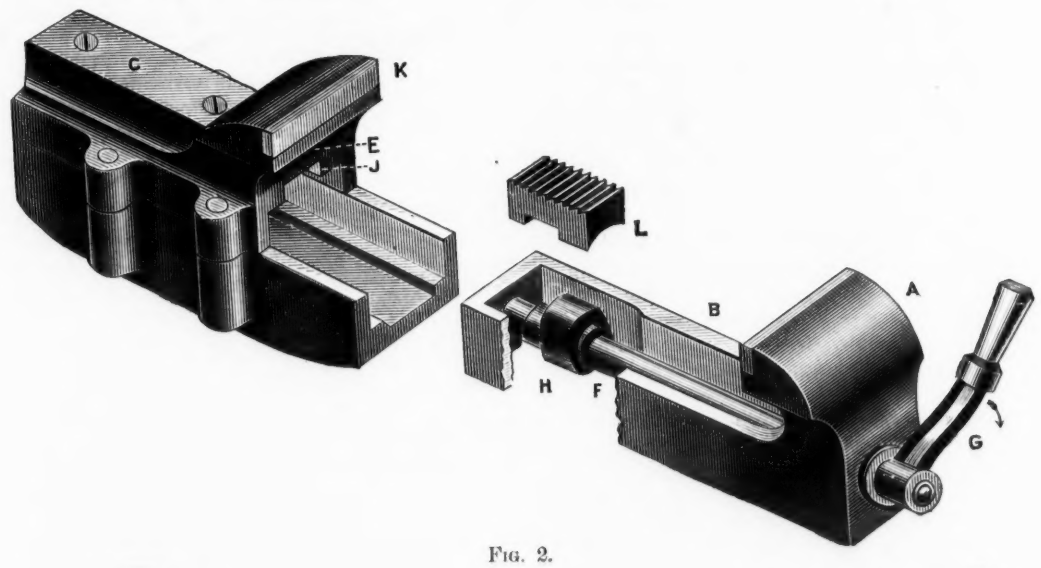
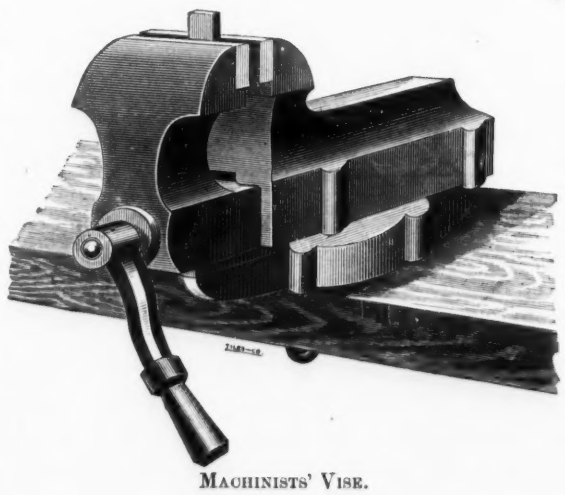
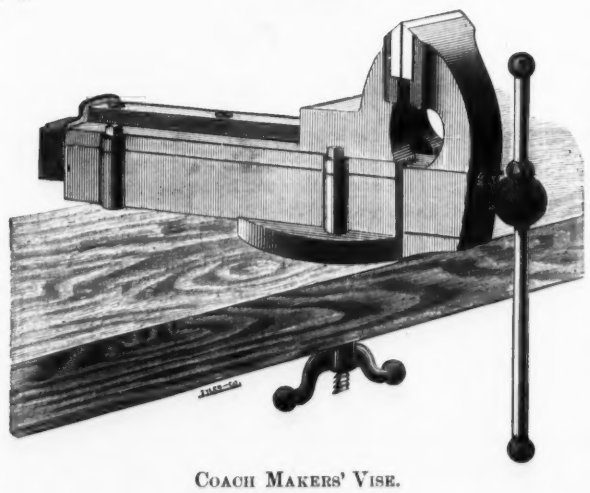


FIG. 2.



MACHINISTS' VISE.



COACH MAKERS' VISE.

Poison in Soda Water Fountains.

Some sensational reports have lately been circulated in New York about the poisonous effects of soda water that has been kept in the ordinary tin-lined copper cylinder or reservoir. The assertion is made that the tin lining comes off leaving the copper to be acted upon by the constituents of the soda water, which dissolve the copper and give the imbibers of the drink a dose of copper salts along with the other ingredients forming soda water. The proposed remedies are numerous. One free-trader proposes to use European-made reservoirs which he alleges do not lose their tin lining, while another is in favor of steel cylinders, as that material will not deposit poisonous salt. We think the case is another version of "much ado about nothing," or that the attempt is made with malice aforethought by the young man of the period who wishes by this means to prejudice the maiden of the period against what to him is an expensive practice of imbibing soda water. As a sequel to this sensation, we expect soon to hear a clamor raised against ice cream. Any agitation that will for one season put a partial embargo upon the free consumption of soda-water and ice cream will benefit the impecunious ladies' man, and if the talk about poison in the soda fountain brings about this result, some one's labor will not be expended in vain.

A genius in the hardware line has devised luminous door knobs which he advertises will "shine all night." Anybody can find the door knob in the dark, but the key hole is what bothers most men who stay out late. A luminous key hole would "fill a long felt want." Where is the hardware manufacturer that will bring out luminous key hole trimmings?

Dangers of a Mountain Railroad.

Following the calling of a train man on the Denver and Rio Grande Railroad seems to be as exciting a business as the most reckless of men could desire. Some parts of the road are about as steep as an ordinary house roof, and the spectacle of trains running away in spite of unparalleled brake appliances is by no means uncommon. Should a train get derailed on any of the common curves sharper than the bend of a mule's shoe, the prospect of the train men accompanying the cars over a precipice a thousand feet deep, or thereabout, is nothing remote. Then the precipices are frequently looming above the track to a giddy altitude, and a rock weighing a few tons tumbling down three or four hundred feet upon a train has a demoralizing effect. Numerous other exciting circumstances readily occur to anyone familiar with the operating of this line; yet, as if ordinary dangers connected with the running of a road through mountain chasms were not sufficiently trying to human nerves, a new source of peril has just been made public. While a working train was passing through a cañon, lately, a spark from the locomotive ignited a box containing giant powder, causing a terrible explosion that disastrously wrecked the train and engine. If trains there carry boxes of giant powder so badly protected that sparks from the locomotive can reach them, the cup of danger appears to be filled to the brim and running over.

Brakes on the Elevated Railroads of New York.

Whoever has enjoyed a good opportunity of watching closely the method of operating the elevated railroads of New York could not fail to become impressed with the importance of the brakes which stop the numerous trains so promptly and smoothly. By standing at Chatham Square Station on a morning or evening, an observer sees trains continuously rushing to and fro with shuttle-like precision, the intervals between trains sometimes being no more than one minute, but each individual train is so thoroughly under control of the engineer that accidents are almost unknown. In the press and among the public there are often complaints about the management of the elevated railways; but we think if any person of a reflective mind would watch for ten minutes the wonderful mechanical spectacle involved in moving all those trains like clock-work, admiration would overcome all other sentiments. The safe operating of these crowded roads is, no doubt, largely due to the efficiency of the brake by whose magic-like power the engineer's hand controls every wheel of the train. The brake doing this marvelous work is the Eames vacuum brake. In two years there has been no recorded failure of the brake, and it is very doubtful if ever an accident of the slightest kind on the elevated railroads was due to the failure of the Eames vacuum brake.

This brake, as its name implies, is operated by means of a vacuum, which is formed in connections that act the part of the cylinder in an air brake. Under each vehicle of the train a kettle-shaped casting, with a loose disk of heavy-rubbered duck fastened over its mouth, is securely attached. This apparatus is called a diaphragm, and it acts as the brake cylinder and piston of the vacuum brake. The center of the diaphragm is provided with an iron washer and eye-bolt, to which the brake lever is attached. All the diaphragms on the train are connected with an ejector on the engine by means of iron pipes and rubber hose. The ejector is a brass fitting, standing upright in the cab of the locomotive convenient to the hand of the engineer. The purpose of the ejector is to suck the air out of the diaphragms and pipes—a duty it effectually performs instantly so soon as the engineer opens its steam valve. Steam is used to eject the air from the train connections, and the height of the vacuum created is constantly before the engineers' eyes by means of a gauge placed upon the face of the ejector. When the ejector exhausts the air from the diaphragms, the atmospheric pressure outside tends to collapse them, just as a concertina is pressed together by the hands. Collapse is retarded by the brake rod attachment, which receives a pull whose tension equals the atmospheric pressure over the whole sectional area of the diaphragm. The brakes are released by simply admitting air into the pipes.

The brake apparatus is subject to continual scrutiny from highly-trained machinery inspectors, and repairs are systematically effected before any part deteriorates so far as to entail the risk of the brake failing.

The New York, New Haven & Hartford Railroad Company have made some important changes in their method of running passenger trains. The trains were formerly run from Springfield to Hartford, and from Hartford to New York by separate locomotives, but the new arrangement makes one engine take the train the whole distance. The engineers will run by the mile for which they receive 3½ cents, a slight increase over the old rates. The change of running suits the men who take the runs perfectly well, but it throws out several men and they do not regard the new plan with favor.

As the prospects for running cars by electricity become promising the number of "original" inventions in this direction increases. It will, if it comes to anything be a promising field for lawyers, who generally get their share of the profits of new inventions.

Early Engineering Reminiscences.

BY GEORGE ESCOL SELLERS.

FIFTH PAPER.

It is often the most trifling thing that changes the destiny of man. I will now return to Saxton and relate as nearly as I can, as he did to me, the incident that decided his course and took him from the farm into the workshop. He had sprung up rapidly, and, as he said, had outgrown his strength. The work on the farm was irksome to him, and every chance he could get he would steal away with an old flint-lock musket, whose barrel he had shortened to convert it into a fowling piece. He said his fondness for hunting and neglect of the farm work greatly distressed his father, who could know nothing of the feeling of lassitude that came over him, and the utter aversion he had for his occupation. Often when he was thought to be hunting, he was lying in the shade of some tree thinking, as he expressed it, of improbable possibilities that might occur to change his father's views and take him from the plow, that was nothing but tramp, tramp back and forth in the furrow, exhausting physical powers and leaving the brain to stagnate. His father, to encourage him to greater exertion in the line he wished him to pursue, on certain conditions, promised him a rifle. He said he was not conscious that he had improved any; that he had worked on as if in a dream, when one day his father surprised him by saying, "Joe, you have fairly earned your new rifle. I am going to Lancaster and will buy you the best one I can find. What bore do you want?" He replied that he did not want less than three balls to the ounce, but he would prefer one-half ounce; that he wanted one that would kill a bear or bring down a deer at long range; but that he did not want any other make than Gibbs. When his father returned with the rifle and put it in his hands he said, "Joe, I think if you lug this heavy thing a day you will soon get tired of fooling your time away hunting; but if it don't suit you, Mr. Gibbs has agreed to exchange it for a lighter one." It was not long before he found he had made a mistake. Bears were growing scarce, the deer season short, the bullets were too large for squirrels and small game, and the rifle too heavy for quick shooting. But his pride was touched, and he was not willing to acknowledge his mistake. He found he could save lead by using a smaller ball and thicker buckskin patch; these patches he thoroughly saturated with melted tallow. One day when starting out on a hunt he primed his rifle, shaking the powder well into the touchhole, closed the pan, and tried to force down a bullet with one of these well-greased patches, but it would not stay down; whenever he loosened his hold of the ramrod, it would rise in the barrel. After several times forcing the bullet down as far as he could by hand grip on the ramrod, and finding it still coming back, he lost patience; he put the end of the wooden ramrod against a tree, grasping the rifle in both hands, and said, "Dang you! you *shall* go down now and stay there." He gave a violent thrust. When he got up from his back, his hands and arms were lacerated and bleeding, and his gun lay some distance from the tree further than he was. When he gathered himself up he was dazed. His first collected thought was what a fool he had been to prime his gun before putting in the powder and pushing down the ball, and then to be so careless as to have set it at full instead of at half cock, as he supposed he had done. On examining his hands he found them badly torn by splinters of the ramrod. He picked up his rifle, expecting to find it had burst. No, it was all right. The hammer with its flint stood at half cock. On opening the pan, the priming was unburnt. Here was witchcraft, or something very like it. On examining the touchhole, he found it plugged with lead hard driven in. Little thought his father, when playing, as he thought, a practical joke in spiking the gun with a lead shot, that it would prove the turning point in his son's life career. Joe was not long in satisfying himself that it was the elasticity of the air being cut off from escape by the touchhole, and the tight piston made by the buckskin patch on the bullet, that caused the bullet to rise; but it did not to his mind account for firing the powder. Thinking it possible there might have been small particles of sand or flint in the powder, he experimented by adding to them; but neither friction nor percussion, as he tried them, would ignite the powder. He asked the schoolmaster, and the doctor, the learned men of the district, but got no solution. He said he cou'd not rest; he lay awake at nights thinking, when it suddenly occurred to him that his gun-barrel was full of air at a certain temperature, and he asked himself the question, "What becomes of the heat in the air if suddenly compressed? would it not be sufficient to ignite the powder?" Acting on this thought he got an old pistol-barrel, polished it well in the bore, plugged the touchhole, fitted a perfectly air-tight piston, on the bottom of which he had a small projecting pin, on which he wound cotton lampwick saturated with powder softened by alcohol, and by sudden concussion ignited it. He was greatly elated, thinking he had made a new discovery. Soon after this he went with his father to Carlisle, and there he saw a glass air-compressing pump, with a little cup in the piston for holding tinder to be ignited by the percussion of the air; and when no tinder was in it the flash of light could be seen. He also found in the hands of boys at the college little brass percussion pumps for igniting tinder. This only increased his longing to get out into the world and learn what was doing and what had been done. His father, finding him so set in this, took him to Philadelphia. All he asked was a chance to learn, and he would take care of himself. Lukens' little shop was just the place. Although Lukens wanted help, he was averse to taking any one for a fixed time under instruction. He said to my father that it was easy enough to get any number, but not so easy to get rid of them if they did not suit him; for no matter how ill they filled the place, he could not turn them adrift. When the circumstance of the discharge of the rifle was related to him he decided to take Saxton, for he said that a boy who could work back from effect to cause was the making of a man. In this case the boy had stretched up to nearly, if not quite, six feet tall.

Henry and Stephen Morris; Samuel V. Merrick and his partner, Agnew, then engaged in building fire-engines; Matthew M. Baldwin, carrying on a general jobbing machine shop, and at the time, if I recollect right, constructing the first hydrostatic presses made in America; the members of the firm of Sellers & Pennock, Rush & Muhlenburg, Prof. R. M. Patterson, Franklin Peale, the inventor and constructor of the first steam-power coining press for the U. S. Mint, were among the enterprising and progressive men of the day, and the conceivers and originators of the Franklin Institute of Pennsylvania. I must not forget to name Dr. Thos. P. Jones, afterwards Commissioner of Patents, and Dr. John K. Mitchell, who were among the first to lecture before the members of the Institute on applied mechanics and chemistry.

I have referred to the small class that Wm. Mason gave instruction to in the use of instruments in mechanical drawing. The lessons were few, and he crowded so much into them that he soon exhausted himself. In the class I worked with were John C. Trautwine, previous to his going into Strickland's office, and while he was yet a pupil of Espy's, Wm. Milnor Roberts, Sol. W. Roberts, Edward Morris, (all well-known civil engineers;) John Dahlgren, (world-wide known as the inventor of the cannon named after him, and as commodore in charge of the United States Navy Yards at Washington,) all at that time pupils of Joseph Roberts at the Friends' School, 4 N. Fifth St., Philadelphia. Among this little band, of which I am alone the survivor, a life-long intimacy and friendship existed.

The number of patent last in the list of July 29 is 302,881.

Brooks Locomotive Works.

Many changes, and all of them improvements, have been effected during the last few years in the Brooks Locomotive Works, Dunkirk, N. Y. From the position of a contract shop, doing business in an inconvenient establishment built for repair work, the Brooks Works have developed into an excellently-arranged engine factory, with all the best mechanical appliances for producing work cheaply and accurately, supplemented by the most improved conveniences for handling the rough and finished material. As these works are located in a place where extensions could be made without paying a fortune for every rod of ground, so the proprietors have been able to enlarge the works to meet the growth of business in a convenient way seldom found about works that have grown up piece-meal. The buildings and yards now cover nearly twenty acres.

Most of the buildings in these works are one story high, special attention being devoted to the lighting arrangements. Except it be trimmings, tires and patent fittings, all the materials put upon locomotives here are worked up from the rough or raw condition. The works have been so arranged that the crude processes shall begin farthest away from the erecting shop where engines are made ready for the road, and that every movement a piece has to make in the progress toward perfect finish will bring it a step nearer to the erecting shop, which is the Rome of the establishment, every road leading thereto. The whole works are traversed by a network of narrow-gauge tracks that provide convenient means of moving material, and one misses the crowd of sturdy laborers tugging at trucks laden with tires, castings and heavy forgings so often seen about large machine works. Traveling-cranes and windlasses are conveniently placed to lift heavy material, and this kind of assistance is used to place all work difficult to handle in lathes, planers and other tools. This system of doing all hoisting by power appliances is made particularly effective in the boiler shop, where work can be swung round to any part inside the building. As the greater part of the riveting done here is accomplished by the hydraulic riveting machines the work needs to be moved round frequently, and convenient means of doing this saves time.

The perfect order and convenient arrangements in the pattern house—which is a fire-proof building lighted from the top—are admirable. The patterns are arranged in tiers of shelves, and are lettered and numbered after a modification of the symbol system once described graphically by Chordal. The pattern house is in charge of an attendant who keeps a debit and credit account of all the patterns, and is held responsible for their order and safe keeping. The order that prevails in the pattern house is well sustained in the objective point of patterns—the iron and brass foundries. Both of these shops are models of neatness and cleanliness, a condition of things by no means common in such places.

To us the most interesting department of the works proved to be the tool room where all the gauges and templates are stored and maintained in order. The interchangeable system of finishing work is very rigidly followed in every article turned out from this establishment, consequently accurate gauges and templates are of supreme importance. There is a fine equipment of Pratt & Whitney's gauges, also a set of those by Whitworth. The former are standard for all measurements, and a complete set is kept as test gauges alone. The greater part of the tools and the templates are made in the tool room, and excellent facilities are provided for doing the work.

A highly efficient fire department is maintained among the workmen, every man having his own place and station. Mr. C. J. Carney is the efficient chief of this organization and takes great pride in it.

The works are not busy with locomotive building at present, and the sensible policy is being followed of preparing now for the rush of work that will come when railroad

companies cannot any longer delay renewals of motive power. Several old tools are being relegated to the scrap heap and their places taken by those of the most approved pattern. Preparations are being made for the erection of a new boiler and blacksmith shop, also a new carpenter shop.

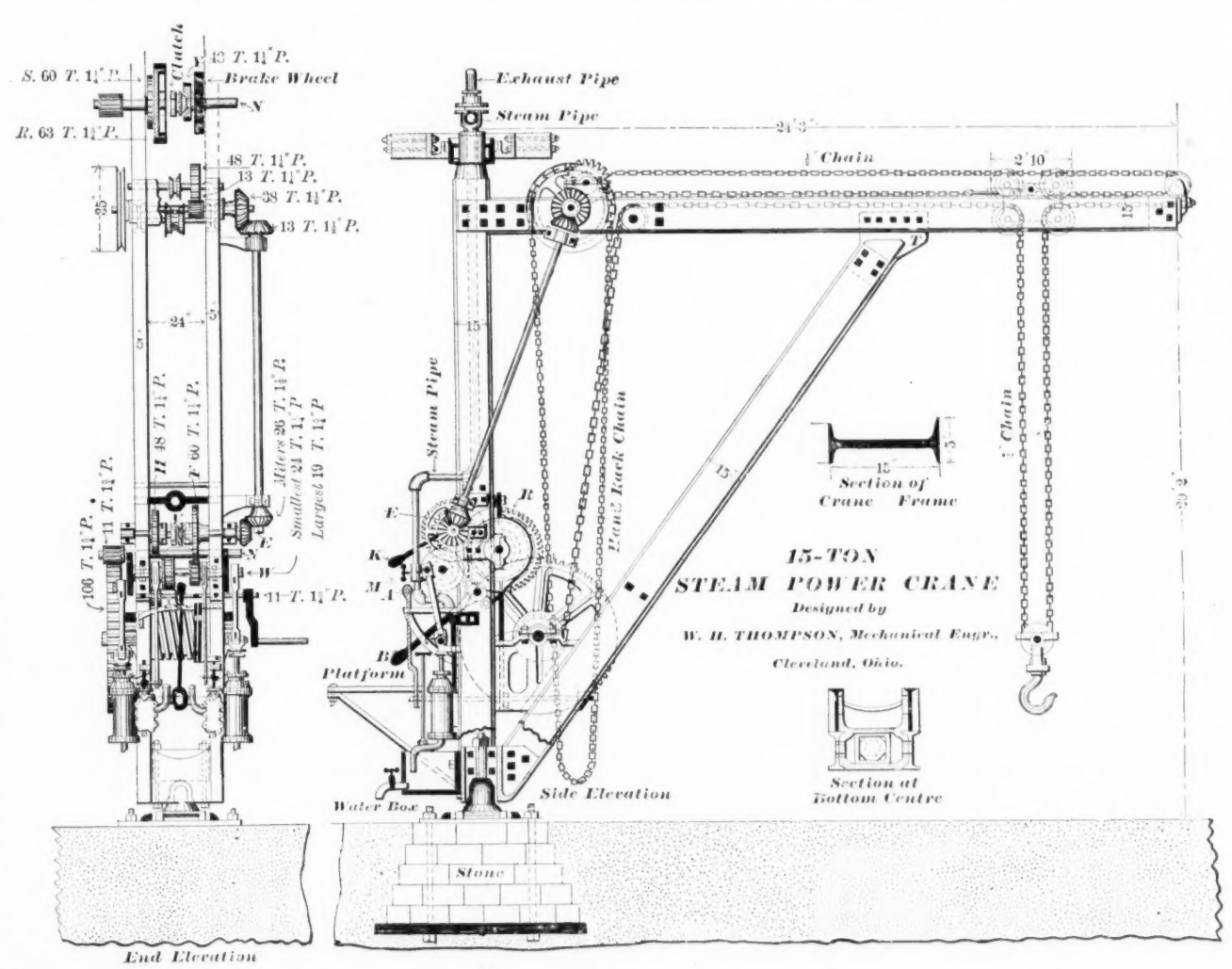
Foundry Cranes.

BY THOMAS D. WEST.

FIRST PAPER.

There are two classes of cranes in general use in foundries: the jib and traveler. In America the jib crane is chiefly used. The designs of cranes in use are somewhat like those of cupolas, very numerous. The designs of some cranes, so-called, are wonderful to behold; all they lack are "wings" to complete their representation of the bird after which they are named. If some of them were to fly away, their loss would not cause much regret. There is probably no foundry tool formerly so illy constructed as the crane. Many were built by men who, probably, never had been inside of a foundry until they were called upon to erect a crane.

To build a good working crane requires not only some science, but also demands observation and experience in their use. The user of cranes should be one fitted to know their requirements. The class of crane which is now receiving much attention is the power crane. The hand crane is giving place to it, and it is only a question of time when the power crane will be as common as hand cranes now are. As there are many who have no idea of the principle of constructing power cranes, and as those who have like to learn of all the styles, I thought it best to begin the subject by the illustration of the power crane. In this I am greatly indebted to the courtesy of Messrs. Griffith and Wedge, the Niles Tool Works, and W. H. Thompson, M. E.



The steam crane here shown is operated, in hoisting or lowering, by the lever *A*, and in racking out or in by lever *K*. The brake-lever is at *B*. The miter wheels, seen at *E*, transmit power to the rack. The arrangement is such that the racking and hoisting or lowering can be done at the same time. Should it be desirable to operate the crane by hand, instead of by steam power, all that is required is to place a crank upon the shaft, as seen, and throw the hand-rack chain into the sheave grooves and loosen the nut at *E*, seen in end elevation.

The cranes used in making these pipes were designed by the same person who designed the one shown here in cut. The crane here shown is one adapted for machinery work, and is arranged so as to be sensitive in its operation. The pipe-shop cranes have four cylinders instead of two, as here shown. The reason for having four cylinders is so as to make the racking and revolving independent of the hoisting gear, and also to save a complication of clutches, gears, etc. The crane here shown is not revolved by steam power, the work not requiring it. The crane engineer stands upon the platform, which is about four feet above the floor, or clear of flasks, etc. A thirty-ton crane, which Mr. Thompson lately designed, has the cylinders and platform about six feet above the floor. The pipe-shop cranes have their platforms about three inches above the ground. The levers, which operate all the movements, are so placed that the engineer can stand in one spot, and the rapidity with which he can change the motion is surprising.

The advantages of power over hand cranes are readily seen where they are in nearly constant use. In this city we have a pipe foundry using several steam cranes. Under one of them, at present, there are being daily cast 110 six-inch pipes. In making 110 pipes it is safe to say two thousand crane movements are required, hoisting and lowering, racking in and out, or swinging. The flasks in which these pipes are made, I should judge, are about thirteen feet long. The castings are made in a deep pit, which, of course, means the pipes are cast on end. To see how quickly the moulds are taken out of drying pit, cored, cast, shaken out, and the flasks set, ready to be again rammed up, would make one think lightning was the motive power.

The gear *R*, and all upon the same shaft, seen in side elevation, were they shown in place, in end elevation, would muddle up the view; so, to save confusion, the shaft *N* is again shown at top of end elevation.

In operating the crane, the gear *R* has motion transmitted from the largest wheel, *W*, upon the crank shaft. The gear *S* is fastened to the gear *R*, and both, like the friction-wheel gear *Y*, are loose upon the shaft. The clutch seen upon this shaft works either way, by moving the lever *A*. As it slides upon a key, which is fitted in the shaft, sliding the clutch to either side, of course, gives motion to the shaft by which hoisting or lowering can be done. The gears *H* and *F*, upon the racking shaft, at *E*, are also loose upon the shaft, and it is not until the clutch is engaged with either of the wheels that any racking can be done. The wheel *S*, on shaft *N*, engages with *H* upon rack-shaft *E*, and *Y* engages with *F*. The small pinion *X*, seen on shaft with crank handle on, engages with *R*. The diameter of the drum is 18½ inches. The pitch line of all the gears is shown in side elevation, so that with the above explanation there should be no trouble in understanding the motions.

A composition for removing scale from steam boilers has recently been patented. The composition consists of a decoction of tanbark ooze and catechu, logwood, chestnut leaves, spruce-hemlock leaves, gall nuts, and sumac bark, and carbonate of soda, oil of sassafras, and alcohol. If that mixture does not make the inside of a boiler sick enough to eject scale or anything else not riveted to the sheets, there is no use trying doctoring any longer for the purpose.

A method of phosphorizing bronze or brass wire, followed by some foreign manufacturers, is the following: The wire is put in a solution of from one-eighth to five per cent. of phosphorus in ether, bisulphide of carbon, or olive oil; five to ten per cent. of sulphuric acid, and eighty-five to ninety-five per cent. of water. In this bath the wire remains till the metal begins to take up the phosphorus. The wire is then drawn to one number finer, and placed in a closed retort with a thin layer of phosphorus, so that the phosphorus vapor may spread over the surface of the wire. After this the wire is packed in charcoal, which is kindled, and after proper annealing the wire is again drawn to a finer number. This process is repeated till the required fineness is obtained. Wire so phosphorized is very tough, takes a high polish, and does not easily corrode.

Mr. G. B. Nichols, who recently resigned the position of Master Mechanic of the Gulf, Colorado, & Santa Fe R. R., has been with the company since they got their first locomotive and he displayed great mechanical ability and fertility of resources in keeping the rolling stock of the road in good condition under adverse circumstances. All the shops belonging to the road were built under his direction, and much of the machinery used was of his design. He retired owing to the growing infirmities of age. Mr. Nichols was for some years master mechanic of the Panama Railroad.

The Government of Mexico has appointed Señor Enrique, a well-known scientist and electrician, as the national commissioner at the Philadelphia Electrical Exhibition.

Although general machine work is very dull at present in Britain, the locomotive-building shops are quite busy. There is so much idle capital seeking investment on the other side, that any prosperous enterprise is almost sure to draw new capital into it. The activity of the locomotive works amidst general depression makes other machine men anxious to engage in locomotive building, and the business is in danger of becoming overcrowded, as it generally is in this country.

American Water Works Association.

The report of the proceedings of the fourth annual meeting of this association, held at Cincinnati, indicates that the organization is full of vitality, and that the members are determined to carry out the objects of the association with zeal and vigor. The aim of the society is plainly expressed by the president, who described the American Water Works Association as a practical set of men seeking instruction and information. It is composed of men in charge of water works all over the country, the actual practice of that business being an essential requisite of membership. The business of the meetings is carried on by the reading and discussing of papers relating to water-works matters. The secretary recommends that the committees, similar to those appointed by the Master Mechanics' Association, be chosen to investigate subjects of interest, and the plan was adopted. The association expects to settle numerous open questions respecting the cost of water supply.

In this way they can do a large amount of valuable work, as wisdom will be sure to come from the "multitude of council." If in addition to what they have planned to do they would, at an early day, take up the subject of the proper method of testing pumping engines, to the end of establishing a general rule for "allowances," etc., it would save a good deal of trouble in understanding the tests of pumping machinery.

Fire in the Baldwin Locomotive Works.

On the evening of August 4th a fire was discovered in the Baldwin Locomotive Works, and it made such rapid headway that the old machine shop was entirely destroyed. This wipes out a historic building, for the shop burned was the first part of what is now the greatest locomotive building works in the world. The shop was L-shaped, and was built in 1834, from a sketch drawn on a piece of letter note paper. By this fire the Baldwin Locomotive Works Company have lost many valuable patterns and the greater part of the gauges and templates used in producing interchangeable work. All the machinery in the shop was destroyed. That consisted of ninety-eight machine tools, consisting mostly of lathes, planers, shaping machines and milling machines, all of them having been of recent make. The offices and drawing office of the works were also burned, and many valuable drawings lost. Great inconvenience will result to the company from the loss of material, designs, and tools, but work on locomotive building will be very little delayed. A larger and much more convenient shop will be at once erected, to take the place of that which was burned. There were about 2,200 men employed in the works before the fire, and some 200 will be deprived of employment for a few weeks, until new tools are got running.

Mechanical Protection for an Open Drawbridge.

Some of the worst railroad accidents known to American annals have happened through trains running into open drawbridges. Numerous mechanical appliances have been invented to make it impossible for a train to run into an open drawbridge, but we have heard of nothing that operates so effectively as an automatic switch in use on the New York, New Haven & Hartford Railroad. At Cos Cob there is a drawbridge which is protected by a safety switch which turns a train on to a sand bank if it attempts to pass while the bridge is open. Recently the engineer of a passenger train thought he would run close up to the draw before stopping, but he reckoned without his host for the automatic switch changed his plans by dumping engine and train into the safety sand bank.

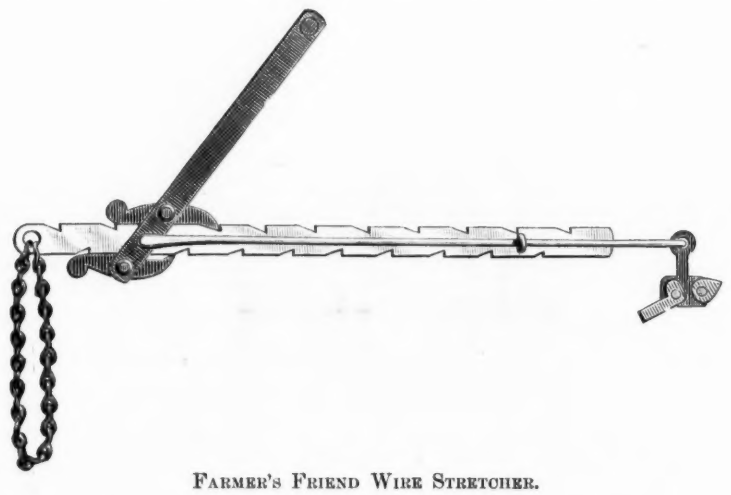
Demand for Smoke "Consuming" in Chicago.

The subject of smoke consuming is an all-absorbing topic among the steam users of Chicago these days. Some time ago an edict went forth from the wise fathers who rule the city of Chicago, that no more smoke would be tolerated from the stacks of furnaces of high or low degree. This brought forth a most fertile crop of smoke-consuming patents and the inventors, or rather adaptors of old devices, naturally expected to reap a rich harvest. Some steam users did not desire to burn their smoke, and they felt that the ordinance forbidding the emission of smoke into the atmosphere was a violation of their free-born rights. Accordingly some of them paid no attention to the behests of the city council, and they were prosecuted and convicted. The case was appealed to the Supreme Court, and that tribunal has decided that the city ordinance is valid and binding. While the case was pending the smoke-consuming ordinance was permitted to fall into abeyance, and the stationary boilers, tugs and locomotives continued to darken the air with the dense smoke that Illinois coal alone can produce. Fortified in back bone by the Supreme Court decision, the council are now determined to enforce strictly the smoke-consuming ordinance, and the situation is becoming full of interest.

Meanwhile the owners of smoke-consuming patents are complaining that their devices are not getting justice, and alleging that engineers and firemen are prejudiced against all smoke-consumers and will not try to make them work. Interviews with several smoke-consuming device owners that have been published indicate that there is widespread discontentment at smoke-consuming patent appliances not meeting with greater favor than they receive from steam users. The fact is that any steam user can equip his furnaces or fire-boxes with excellent smoke-preventing devices that are not patentable, because patents upon them have expired many years ago. A brick arch or bridge to deflect the flame and the means of regulating the admission of air above and below the grates form the best combination that has ever been tried for smoke prevention. In the hands of a careful fireman of ordinary skill this arrangement will prevent all trouble with smoke, and any steam user can apply it without fear of infringing any patent.

Farmer's Friend Wire Stretcher.

Western farmers have come to the conclusion that the cheapest fence that can be put round a farm is made with good steel barbed wire. In consequence of this the business of putting up wire fences has become a regular part of farm work. Unless the wires of a fence are properly tightened the fence loses part of its utility, and a cheap yet effective wire stretcher may be regarded as a farmer's friend. To supply this want Mr. Ed. Long, Iowa City, invented the stretcher illustrated on this page. It consists of a notched bar which is traversed by a lever carrying two pawls that automatically engage in the notches, thereby drawing the ends of the wire towards each other. The device is exceedingly simple and made of parts that are not likely to get out of order. It is made by Long & Graham, Iowa City, Ia.



Farmer's Friend Wire Stretcher.

LETTERS FROM PRACTICAL MEN.

The Hardening and Contraction of Steel.

Editor American Machinist:

Going the rounds of the trade journals are two articles, copied from high authority, on steel, and its behavior, which should have a little ventilation. It is to be hoped that there is no foundation for the assumption of the writer of "Hardening Steel," that there is a common belief that the colors produced by heating brightened steel are dependent upon the steel having been hardened, and that in stating that "brightened steel that has not been hardened may respond in after heating to several of the tempering colors," —this being given as "one reason why common steel articles are not thoroughly hardened"—he is advancing anything new. Mechanics generally, and those who are not mechanics as well, who have had occasion or opportunity to observe the effect of heat upon a bright steel surface, know that the colors do not depend upon the steel having been hardened, or otherwise, but that all the different colors appear on soft steel, or upon iron even, and that the color is only an indication of different degrees of heat to which the steel has been subjected; not an indication of degrees of hardness or temper at all, except it is known that the steel had been hardened previous to the coloring by heating.

Next, the writer of the article says: "It is not uncommon to see a forger or temperer heat a piece of cast steel to a very low red—a red that shows only in the shadow—then brighten and draw the temper to color, when the after-trial proved that the steel had never been hardened. Indeed, the dull red that some smiths use in hardening is that at which a red annealing may take place, the piece being heated to a dull red and plunged into water."

How nearly correct is this? Is it not rather the fact that it is not uncommon to see steel heated for hardening to a bright red or yellow heat—much too hot for the good of the steel—and the tempering to overcome the brittle, weak condition produced by hardening then carried so low as to leave the piece, which was hard as glass, too soft? Remonstrance with the men who harden and temper in this way brings the reply, "It can't be helped; left any harder it will break." Too hot means ruin. Not hot enough permits re-heating and hardening without perceptible injury. Just right as to degree of heat in hardening steel makes temper-drawing a less important matter, and for many uses an entirely useless waste of time. Superlatively best hardening comes from the low heating which the above quoted statements would be likely to lead readers to avoid. The *lowest heat* at which steel will harden to the degree of hardness required is the *best heat*. Any teaching which leads in the direction of high heating which produces a brittle, weak condition, and then points to temper-drawing as the cure, is mischievous.

"Red annealing" is a misnomer; it is a process of hardening, not annealing. Because a piece of steel, which has been "cold water annealed," can be worked, or because it is softer than before it was put through the process, does not establish the fact that it is a process of annealing. The same piece, permitted to cool off without plunging into the water, would have been softer.

"The first requisite in making a cast-steel tool into a working tool is to harden it. After its hardness is proved then it may be tempered to the condition required. There is no intermediate process of properly tempering between absolute hardening and subsequent drawing." The above quotation, from the same article, seems like good sense. Of course it should be known before drawing the temper if steel is hard, but the ability to temper to proper condition simply because it is hard, is quite doubtful. Tested with a file, and found thoroughly hard, one piece of steel may stand at a light straw, or, for that matter may stand without drawing at all, while another piece, of the same shape and size, from the same bar, tested in the same way and found equally hard, may need to be drawn to a purple, or even a blue, to stand indifferently well, being really too soft, but left any harder it will break.

To the positive statement "There is no intermediate process between absolute hardening and subsequent drawing," an answer may be found in the fact that for many uses requiring superior cutting qualities, added to great tenacity, tools are, *by proper care about the heat at which they are hardened*, used without drawing the temper. To put in the proper condition by hardening—not by tempering—is the one thing needful in making good tools. Heated above the exact degree of heat required, each degree of heat added is an injury to steel, calling for correspondingly more letting down of temper, and proportionately lowering the standard of work of which the tool is capable. Instead of "no intermediate process," it is truly a process of intermediate conditions all through.

Copied from the same scientific journal, under the heading "Contraction of Steel," we are asked to believe that "the hardening of cast steel generally contracts it," and that "a plug gauge was re-hardened six times to reduce it to size," ought, perhaps, to settle the question, but it is likely that so many readers have found the exactly opposite result that there will be a protest against accepting the statement as fact, however high the authority.

If a cylindrical gauge should fail to fit a plug gauge because it was too large, or the plug gauge too small, expanding the plug gauge by hardening, or contracting the ring gauge in the same way, might produce the desired effect; but the men who have ground out the holes in thousands of milling cutters after hardening, to get them to go on the same arbor which they slipped on to easily before, or who have driven hardened steel pieces with a hammer into holes which they would drop into of their own weight before hardening, must be excused if they do not readily set aside the result of their own experience and agree with this writer, who seems so sure that he has gone to the bottom of the whole matter. That steel may, and possibly does, contract in hardening when small in section and hardened through, the hardening being done at the low degree of heat which refines or places the steel in the most compact condition possible, may be true; but it is not true of pieces of steel hardened at the ordinary high heats used, or of such sizes as do not harden clear through. In ordinary everyday practice steel may be said to expand in hardening. The contraction of a hole in the center of a block of steel or die is due not to contraction in hardening, *per se*, but indirectly to expansion, and depends upon a sufficient amount of steel surrounding the hole to produce the effect. The hole an inch in diameter, which shrinks in size in hardening a milling cutter so that the arbor will not enter, would expand if, instead of being in the center of a block of steel of three or four inches in diameter, it were in a collar $1\frac{1}{4}$ or $1\frac{1}{2}$ inches diameter.

"A recent case showed a plug tap and a reamer made from the same bar, both of which expanded in hardening." This is apparently spoken of as a remarkable instance, when the fact is that to have done anything else would have been unusual. Quoting again: "This quality of cast steel (contraction in hardening) is one that is generally accepted as belonging to the metal; but there are instances where expansion rather than contraction has taken place from repeated heatings, hardenings, and annealings." Next comes a reflection not complimentary to steel or its manufacturers, because all steel will not contract according to the theory of this writer.

That cast steel changes in volume in hardening there is no question; but it expands in ordinary practice instead of contracting. Highly carbonized steel changes more than steel of lower temper. The amount of change is largely dependent upon how it is heated and hardened. The words "unlucky" and "unreliable," as applied to the character of steel and its "behavior" in the article under consideration, would apply with equal force to the treatment which the steel receives. That "steel from the same invoice behaved in ways exactly opposite" is not strange, for there might be an indefinite number of different steels requiring different treatment in the same invoice.

If the intention was to say that steel could not be had which would show uniform results from uniform treatment, there must have been exceptionally bad luck to call forth such an opinion. For a certain kind of dies used in drawing up sheet metal it is considered quite necessary to use a steel which, by rehardening after wearing above standard

sizes, will shrink, and the more times it can be rehardened with this result, other qualities being equal, the more valuable the steel is considered. A certain grade or temper of steel is required for the above use, but once the grade is fixed upon there should be no further trouble, except to continue to order the same from reliable parties.

The excuse for this criticism may be found in the fact that more than thirty years of practical steel working has convinced the writer that too much importance is attached to tempering, and that to *harden* before tempering is considered sufficient; when the questions, how hardened, or what condition the steel is placed in by hardening, are of a thousand times more importance than any question relating to temper drawing. The many cases in which taps or reamers, which had been worn too small by use, have been made to cut the original size, or even larger, by rehardening, with a distinct recollection of having ground thousands of pieces of hardened steel in order to get them into slots, or holes, into which they dropped before hardening, will not permit an acceptance as facts of the statements to be found in "Hardening Steel" and in "Contraction of Steel."

If pieces of steel of any considerable size could be hardened clear through, or the cooling from a heated and expanded condition on plunging into the bath could take place simultaneously clear through the heated mass, the results might be different; but mechanics must deal with facts as they find them. S. W. Goodyear.

Waterbury, Conn.

Dead True Surfaces for Iron Planes.

Editor American Machinist:

There was a time when the long wooden jointer was considered an indispensable tool in the pattern room, and the longer it was the better, and the man who was the possessor of one of these tools was supposed to be able to make a pretty good joint, although I have seen as good a joint made with a jack-plane as I ever did with a jointer. In fact, it depends a good deal upon the man, and not altogether upon the tool. When the iron planes were first introduced, they were supposed to be pretty near perfection. Still, on trying them on a surface plate, they are found to be quite a little out of true. Some one suggested scraping them down to a surface plate. I think the idea originated in Prof. Sweet's shop. It was done; and now it is a common thing to plane up two pieces of wood so that one will pick the other up. Of course this can be done with a wooden plane, but they get out of shape easily, being affected by dampness in the atmosphere, and also by driving the wedge in too hard.

C. R. C.

The Perfect Screw Problem.

Editor American Machinist:

I am greatly disappointed at learning, as I do by the American Machinist of August 9, that in describing my method for maintaining the accuracy of the perfect screw I so failed in making a clear statement as to be misunderstood, especially by Geo. F. Ballou, who of all others it would have been expected would have given the matter more than a passing thought.

Only on the supposition that I was misunderstood can I see the application of his criticism. As he admits the possibility of keeping the screw perfect by using a nut of the same length, and as that was all I sought to do, there is no room for argument, but a little for explanation possibly.

The explanation is simply this, that I did not propose to cut any screws more than sixteen or eighteen inches in length, which, with a screw and nut of ten or twelve inches in length, would require no moving of the master screw on the feed-rod. The object of having the master screw adjustable along the feed-rod was simply to meet cases where screws are to be cut on the end of long pieces.

I can readily imagine that hundreds of people may ask, "What would a lathe be good for that you cannot cut a long screw on?" and my reply would be that in ninety-nine cases out of every hundred, for nine lathes out of ten, it would be just as good as any other, and I would no more think of making a lead screw for a lathe, or the lifting screws of a planer cross-head, on this lathe than I would think of making a steamboat shaft in a watch lathe. There are a great many machine tools that will not do everything, but that will do certain things very well. John E. Sweet.

Syracuse, N. Y.

Rod Brasses Made Practically Solid.

Editor American Machinist:

I have found the following the most practical method, in my experience, for removing "pound" and taking up the lost motion occasioned by the constant wear of connecting rod brasses, and making the end practically solid.

I will take, to explain, a pair of brasses fitted to a strap previous to being bored. Instead of bringing the brass ends, or rather the butting surfaces, together, insert between them twelve slips of No. 30 hard sheet brass; this will separate them an eighth of an inch, when they can be bored to fit whatever intended for.

The operation necessary to take up any lost motion is simply the removal of one of the slips, when the strap and jib can be replaced, and the key driven down hard. It is obvious how solid the rod end then becomes, running continually brass bound and perfectly square. By this means there is no necessity for using a file, and all grit and dirt are excluded. I have found removing a slip as alluded to above to remove all pounding or thumping, as any distance greater, between pin and brass, will cause more or less of it. I think the above might be made use of by "W. W. F.," Morgantown, W. Va., in "Questions and Answers" of July 26, 1884, except that he would be required to file his boxes perfect and insert a sufficient number of slips until they are properly separated.

If "Engine Makers" would look a little more into the convenience of adjusting parts that are liable to wear, they would receive more praise (advertisement really) for their machines. Wm. M. Linnett.

Newark, N. J.

Cleaning Boilers.

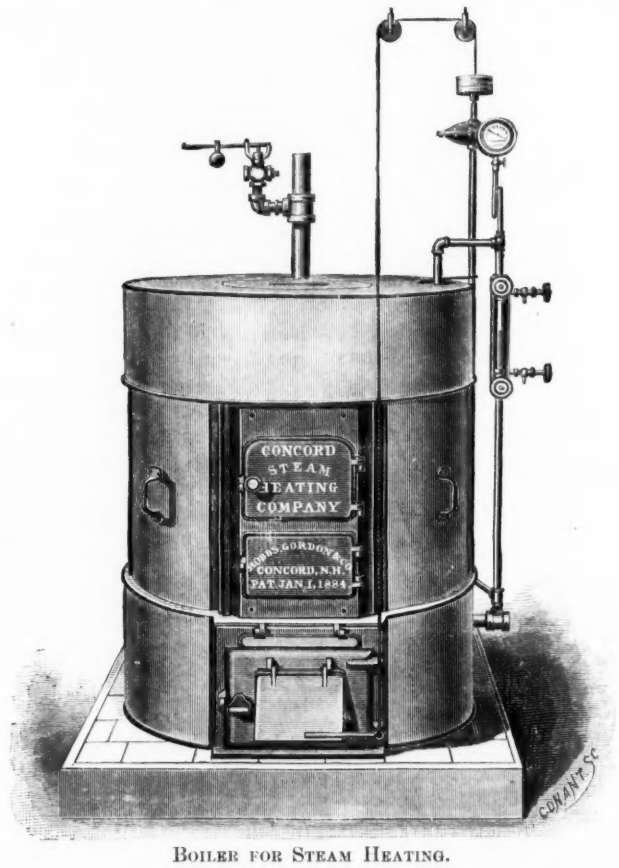
Editor American Machinist:

Having seen several letters on boiler cleaning, I will add my experience. I have tried my plan for several years, with good success. Previous to adopting this plan, I used all kinds of compounds, with about the same results, viz: injury to iron, and foaming boilers. I attach to my boilers a surface blow-off, and use this freely every day about 11 A. M., when all the scum and sediment of water is on top. Then, in the morning, when the boiler is cool, I open the mud valve and let the water run until it is clear. Never blow off the boiler when hot, or when there is any pressure on. Let it cool off, then let water run off, take out hand-hole plates and thoroughly wash with hose. Wash out as often as needed, generally every two weeks. If the boiler is scaled, a few quarts of crude oil, put in every time it is washed out, will remove the scale without injury.

Will you please give me your opinion of feeding boilers on top. We are putting in a new boiler, and I want to feed it on top, that is, by running a pipe in from the top below the water line. I have seen several boilers fed this way, with good success, and think it preferable to feeding water on sheets, but I am opposed by the machinists. Water is fed by a Knowles pump through heater, which heats it to about 200 or 212 degrees.

E. D. Sidman.

[We have never heard of any trouble from feeding boilers as indicated.]



Boiler for Steam Heating.

Melting Steel in an Ordinary Cupola.

Editor American Machinist:

Some time ago, at the close of one of my letters, I stated the steel plow works connected with this business used 100 tons of steel per year. I should have said 1,000 tons. I asked the readers of the American Machinist if any of them could give me information on melting steel in an ordinary cupola. I have received quite a number of letters from gentlemen asking me if I had tried it, and what success I had met with. I have just got to the point where I can answer with some satisfaction, and, begging the pardon of those who have written me for my *seeming* lack of courtesy in not replying, I will, through this medium, answer all at once.

I read an article, translated from a foreign publication, on "Tempering Cast Steel," which closed by saying: "Any foundry can make it with a small outlay for cupola and tempering furnaces." We have on hand 75,000 pounds of steel scrap, which the firm could not even get a bid on, and, as we make upwards of 200,000 pounds of cast plows in a season, it suggested the idea that we could make cast-steel plows. I had some experience in steel mixture, but knew nothing about steel alone, or if it would melt in an ordinary cupola. The first time I tried it I charged 1,000 pounds, at the end of the heat making no difference in ratio of fuel and metal for iron. The result was, it was not fluid enough to run the mould. After that I let my cast-iron portion of the heat run out pretty low, then rebuilt my bed at the rate of one pound of coke to five pounds of steel, increased the blast and melted 1,500 pounds of very fluid steel, and am melting from 1,200 to 1,500 pounds every day into plow shares, which are stronger and tougher than chilled cast-iron. For that class of work it is first-class. I believe it would make good bells for farm-houses and country school-houses.

It is a bright, beautiful metal in the fluid state, and throws off an abundance of sparks. We pour it in green sand moulds, and it does not scab or eat into the sand. I send by mail a sample, which I gave to an expert blacksmith on steel to see what it would do under the hammer. You will notice back, of the hole drilled in sample, it has been cut off with a cleaver clean through. Forward of the hole you find where it has been hammered out from $\frac{7}{16}$" thick to a sharp edge, both of which were done at a very low heat. The hole was drilled before heating, and cast-iron as white as that was could not have been drilled in the ordinary way. It can be given a temper so hard a file will not have any effect on it, but it then becomes very brittle. The piece sent is from an imperfect casting. When the moulds run full, as they do now, it is not near so porous; the metal does not retain its "life" very long, and has to be handled quickly.

Robert E. Masters.

Columbus (Ga.) Iron Works.

Mr. Durgin, the well known locomotive builder, who has been traveling in Europe ever since he left the Rhode Island Locomotive Works, over a year ago, has just returned home, and he has accepted the position of Vice-President and General Manager of the New York Locomotive Works, at Rome, N. Y. While in Europe Mr. Durgin studied closely railroad machinery used in the different countries visited. He devoted considerable time watching the performance of the Webb Compound Locomotive, and he came away very unfavorably impressed with that engine.

Boiler for Steam Heating.

The engraving represents a boiler made for steam heating by the Concord Steam Heating Co. (Hobbs, Gordon & Co.), Concord, N. H. In this boiler two rows of water tubes connect the water space at the bottom with the water chamber above. The inner row of tubes being nearest the fire causes an upward current through them, while the cooler water descends through the outer tubes, thus providing for rapid circulation. The disposition of parts is such that the products of combustion must make a complete circuit before passing to the smoke pipe, thus providing a long run in comparatively small space, and also providing for bringing the hot gases in contact with the heating surface in a very effective manner for the transmission of heat.

By removing the sectional casing which surrounds the boiler all the tubes are exposed, and every part of the flue between the two courses of tubes can be reached and cleaned with a brush, as well as all other parts requiring cleaning.

The fire-box is brick lined, and the grate can be readily shaken or dumped.

The boiler is provided with all necessary fixtures, including an approved damper regulator. It occupies small space, is simple in its arrangement, and easily managed.

The *American Miller*, in reviewing the considerations which lead to an advance in wages, says:

"It is useless to expect the employer to first raise his employe's wages, trusting that the latter in return will give more service or more efficient service. The employer does not reason that way; and the employe who does—who says to himself, 'I am paid $12 a week, and I will not do $15 worth of work'—will probably never get more than $12 a week. We are not justifying the facts, merely stating them. The facts may not be just, but they exist, and the extra work always precedes the extra pay."

Soldering Aluminum.

The use of aluminum in the arts has been much restricted by our ignorance of any method of soldering it, either to itself or other metals. Now, however, a French engineer, M. Bourbouze, has discovered a way of effecting both classes of the operation with ease. The process consists in plating both surfaces to be soldered, not with pure tin, but alloys of tin and zinc, or tin, bismuth and aluminum, etc. Good results are obtained with all such alloys, but those containing tin and aluminum are best. They should contain different proportions, according to the work the soldered parts have to do. For parts to be fashioned after soldering, the alloy should be composed of 45 parts of tin and 10 of aluminum, as it is sufficiently malleable to resist the hammer. Pieces thus united can also be turned. Parts which have not to be worked after being soldered, may be united with a soft solder of tin containing less aluminum. This last solder can be applied with a hot soldering iron, as one solders white iron, or even with a flame. Neither of these solders requires any prior preparation of the pieces to be soldered. It suffices to apply the solder, and extend it by help of the iron over the parts to be joined. When, however, it is desired to solder certain metals with aluminum, it is best to plate the part of the metals to be soldered with pure tin. It is sufficient then to apply to the part the aluminum plated with alloy and to finish the operation in the usual manner.—*Engineering.*

The Chippewa *Herald*, of Chippewa Falls, Wis., dated July 25, contained the following: "The Badger State Lumber Company has started out on a new and certainly a just scheme. Heretofore the hours for labor in the mills on the Chippewa have been from 11 to 12 hours. General Manager Ben Sweet, of the Badger State Co., concluded last week that this was too long for men to labor, so he cut the hours that employes have to work for his company down to 10, and the mill manufactures just about as much as before. Ten hours is as much as a man ought to work, and the *Herald* predicts that within a short time 10 hours will be considered as a day's labor in all the mills."

Tests of the New Cruisers' Boiler Sheets.

The Naval Advisory Board prescribed very rigid tests for the steel used in the new cruisers being built by John Roach. The plates of the boilers now under construction at the Morgan Iron Works in this city, have each individual sheet tested. The ductility in eight inches must not be less than 25 per cent., and the ultimate tensile strength must not be less than 57,000 pounds. The test pieces are cut from the sheet, and without annealing, subjected to the breaking strain in a testing machine. The initial stress is made as near the elastic limit as possible. A quenching test has to be made for each sheet, a piece being cut out and heated to a cherry red, when it is plunged into water at a temperature of 82° Fahrenheit. Thus prepared, it must be bent under a press or hammer so that it shall be doubled round a curve of which the diameter is not more than one and a-half times the thickness of the sheets tested without presenting any trace of cracking.

The *American Artisan*, of Chicago, in discussing the growing practice of countermanding orders for goods says:

"It would seem scarcely necessary to call attention to a matter of this kind, but the fact is that countermanding orders has grown to be a serious evil, and the average dealer has come to look upon it as a matter of course that he has a right to countermand an order at any time after giving it.

"A case in the United States Court has just been decided by Judge Blodgett, in this city, denying the right to countermand an order. The case of Lockhine vs. Enard was a suit for a bill of goods sold by plaintiff to defendant July, 1883. After giving the order to plaintiff's drummer, defendant countermanded the order by letter and telegraph, and refused to take delivery of goods. Judge Blodgett held that the order was a contract, and could not be voided by merely countermanding it. Judgment was therefore entered for plaintiff.

"This is not a new thing, as the question has been decided before, but dealers generally do not seem to know the fact. Of course there may be in rare instances sufficient and proper reasons for countermanding an order. But in such instances the dealer will not fail to secure the desired favor by communicating with the house from which the goods were ordered."

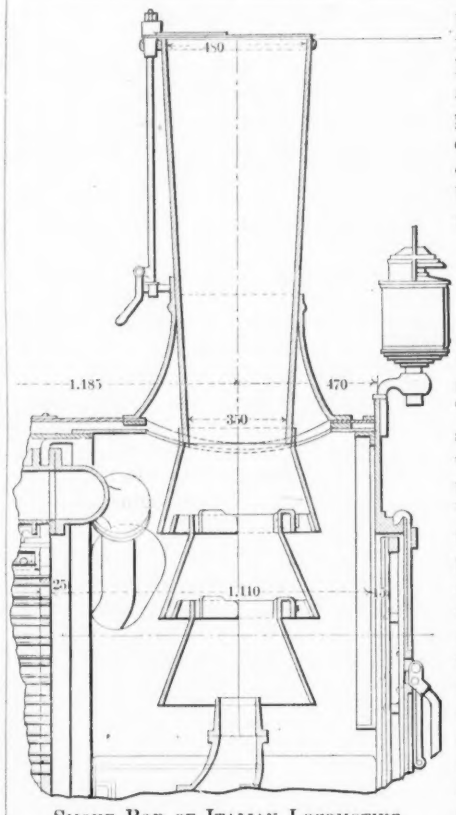
The Indicator Diagram.

By F. F. Hemenway.

DIAGRAMS FROM AN ENGINE WITH LEAKY VALVES.

The diagrams reproduced in Figs. 31 and 32 were sent me by an engineer, with the request for an opinion of them, particularly with reference to "the large toes" at *T*, on those from the head end of cylinder. They were taken from a Corliss engine 20″x60″, running at 57 revolutions; boiler pressure 70 pounds. Diagrams 31 were taken under ordinary conditions, and 32 after readjustment of valves, conditions otherwise the same.

The diagrams are not good ones, and those taken after valve adjustment are no improvement on those taken before. In both cases the pressure falls several pounds before cut-off, it being impossible to locate the point of cut-off by the eye. This is mainly owing to full steam being carried so far in the stroke, still it would seem that the steam valves might be made to close more rapidly, and thus bring about an improvement in this respect. If practicable, it would be an improvement to carry higher steam pressure—



Smoke Box of Italian Locomotive.

say 80 pounds. This would bring about shorter and sharper cut-off, and undoubtedly better economy.

The change in the valve motion, as will be seen, has not resulted in equalizing the work done against the two sides of the piston; on the contrary, while it has transferred some of the work from one side to the other, it has materially increased the inequality between the two sides. The best economy results when the work done on the two strokes is equal.

Another fault, and this is what causes the "toes" referred to, is that the exhaust valves open too late—apparently not till quite the end of the stroke. The chief reason why this defect is so much more prominent in the diagrams from the head end is, that the terminal pressure is much higher on that end than on the crank end. Thus, in Fig. 31, with one pound less mean effective pressure on the head end, the terminal pressure is six pounds higher than on the crank end. The fact that so much more steam must be got rid of is the cause of the counterpressure at and near *T* being so high. Opening the exhaust two or three inches earlier in the stroke would remedy this.

But the diagrams show evidence of a much graver fault than any mentioned, viz: leaky valves. The clearance not being known it is not possible to locate the theoretical expansion curves, but it is plain to be seen without doing this that the termination of the actual curve of the diagrams from the head end is several pounds too high, undoubtedly caused by a leaky steam valve—in other words, a good deal of steam leaks into this end of the cylinder after the steam valve has closed, this leakage resulting in very material loss. It is also reasonably plain that the terminal pressure on the crank end is too low, and that the exhaust valve on that end—either that or the piston, probably the former—leaks. It is possible, and probable, that all the valves leak, but that on the head end the steam valve leaks more than the exhaust valve, and that of the crank end the contrary is true. These leaks are serious in their effect on coal consumption, and the saving brought about by properly seating the valves would pay the cost in a few days.

With reference to the remark on higher steam pressure, it ought to be said that in all probability higher pressure with the valves in their present condition would result in loss rather than gain. The diagrams show good admission lines and initial pressure reasonably near boiler pressure, considering the piston speed; those from the crank end, however, showing apparently better valve opening at and near the beginning of stroke than those from the head end.

Fig. 31—Scale 40

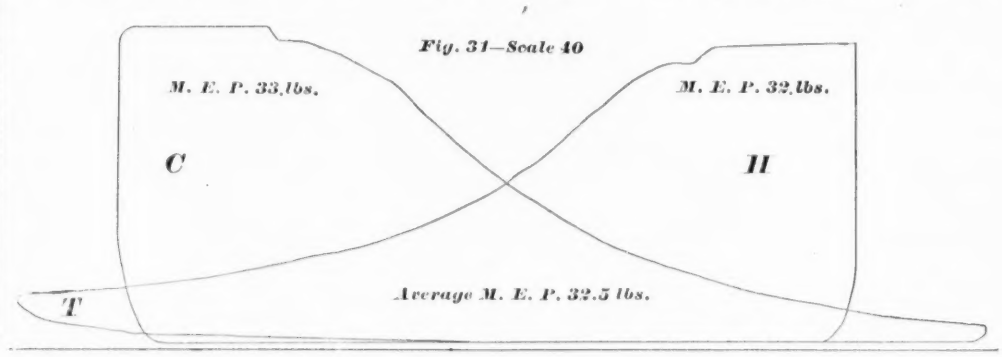
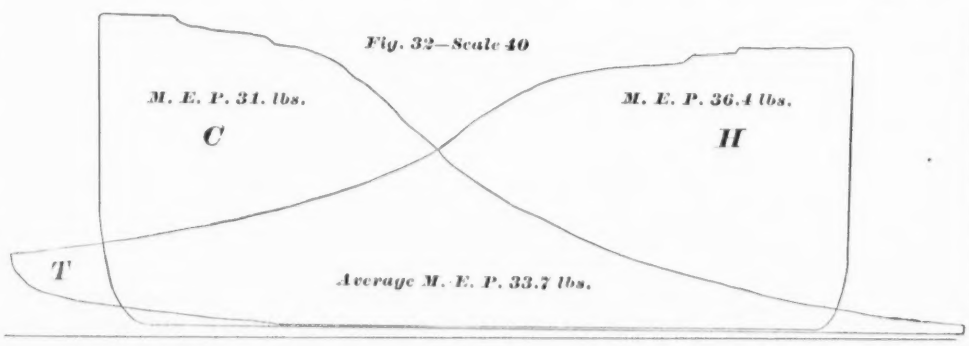


Fig. 32—Scale 40



An Italian Locomotive.

In a recent issue *Engineering* devotes three pages to illustrating a ten wheel passenger locomotive, recently constructed at Turin for pulling passenger trains on the steep grades common to the railways of upper Italy. The engine at the first glance might be taken for one of the New York West Shore and Buffalo Railway locomotives, so many American features does it possess. The cylinders, whose dimensions are a little over 18x24 inches, are outside the frames and have the slide valves on top, the steam chest standing in an inclined position. The Gooch valve motion is used, the eccentrics being carried by return cranks. The most Americanized portions of the engine are the fire-box and smoke-box. The former stands above frame and is inclined upwards at the back to give room for the trailing axle. The crown sheet is stayed direct to the outer shell, the tendency of the latter to spread transversely being resisted by strong cross-stays. The fire-box is 7 feet 2 inches long and is supplemented by a combustion chamber 2 feet 11 inches long which still leaves 12 feet 6 inches of length for the tubes. The boiler and fire-box combined extend a length of 26 feet 10 inches and give 1334.8 square feet of heating surface. A low exhaust nozzle is used and the smoke-box has a petticoat pipe constructed like the tubes of a Friedman injector, the upper tube being riveted to the stack. The smoke box arrangements appear to improve over our methods, and seem worthy of investigation. For this reason we reproduce the smoke-box in the annexed cut.

A Mexican Cotton Mill.

Rather more than a year ago the Watts, Campbell Company, Newark, N. J., sent one of their compound Corliss engines to Pueblo, Mexico, to take the place of two oscillating compound engines that had been running a large cotton mill. The engineer of the works, Mr. Hopkins, has been recently in this city, and he reports that the new engine, which cost about $16,000, has in one year saved over $25,000 in fuel expense. The fuel used is wood, which has to be transported a long distance on the backs of mules, rendering it very costly. The factory is a large building where two thousand hands are employed. They work from sun rise till 9:30 P. M., which is considered the regular hours of labor. For this wages averaging 25 cents is paid. The product turned out is a coarse grade of very inferior quality which sells for about 12 cents a yard. The chances are that manufacturing establishments of this kind would find it hard to keep running should Mexico inaugurate a free trade policy.

The industrial situation in England is very depressing. The *Northern Evening Express*, of Newcastle-on-Tyne, in discussing the matter says:

"We need something to set the idle mills and factories going, to employ the men in peaceful occupations, for it is said that soldiering is all that is left for some at present, and that the applications at the barracks are numerous, because men have applied at factories till they are tired, and receive but one answer, "We have nothing for you to do." The recruiting is going on fast, not from a love of the service, but from the want of employment anywhere else. It is a sad state of things when the barracks or the "Bastile" are only open for men willing to work, and when soldiering is taken to because even laboring work cannot be had. This ill wind

is benefitting the Government in filling the depleted ranks of the army; just as the cholera is giving new life to the chemical trade, because of the extra demand there is for chloride of lime."

The Brown & Sharpe Universal Cutter and Reamer Grinder.

END GRINDING HEAD.

In our issue of August 2d, we illustrated this machine, and also published engravings representing some of its uses. Herewith we represent an attachment used with the machine, called the end grinding head. With this attachment the faces of cutters, sides of mills, hollow and end mills, counterbores with removable tits, etc., etc., can be sharpened or re-cut.

Fig. 14 represents the head attached to the left-hand end of the main bar *A*. As shown it is in position for either re-cutting or sharpening a right-hand end-mill.

In Fig. 15 the arrangement is for a left-handed mill.

Fig. 16 is a side view, showing position of wheel at full depth for re-cutting. Fig. 17 shows position of cutting edge as it passes the wheel on an angle, and Fig. 18 the position of mill for touching the corners to "even up."

The parts are so constructed that adjustment is readily and accurately made for mills or cutters with any number of teeth, also for grinding, hollowing, straight or crowning, to suit the requirements of mills for different purposes.

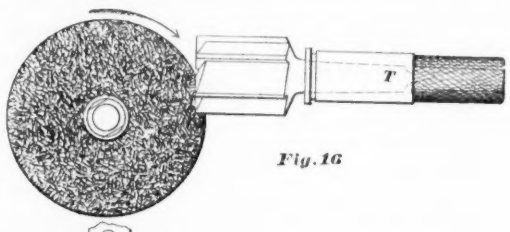


Fig. 16

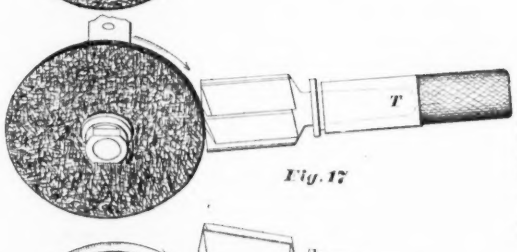


Fig. 17

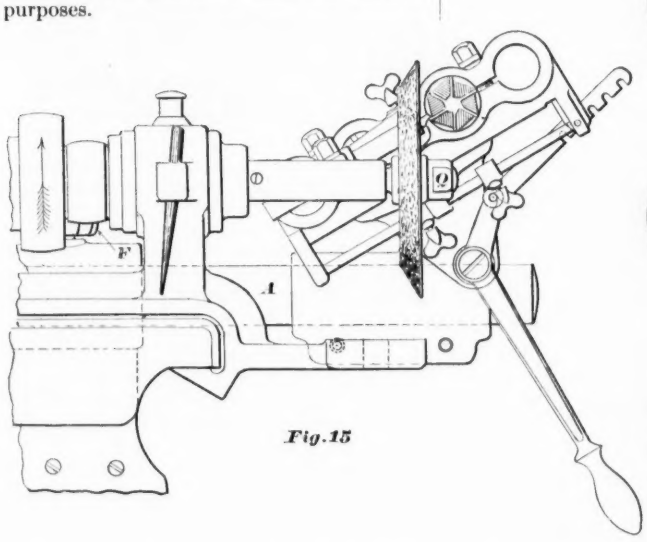


Fig. 15

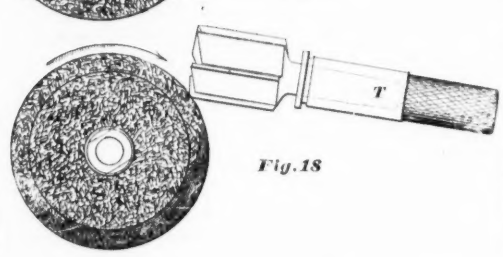


Fig. 18

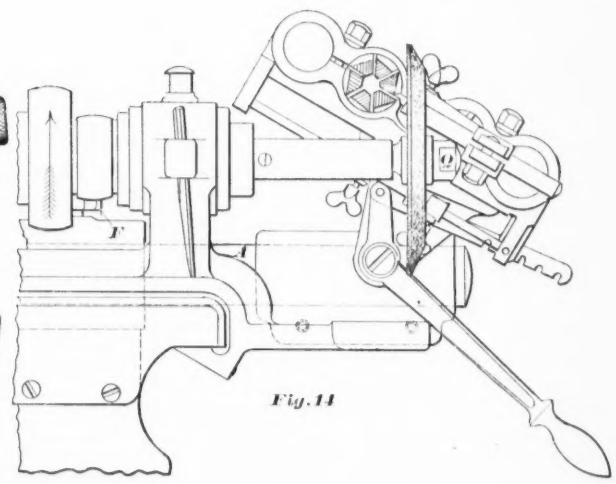


Fig. 14

Inertia — Its Nature and Means of Measurement.

By Ed. F. Williams.

Heretofore I have dwelt briefly upon the distribution and effect of inertia in the reciprocating parts of an engine, and have explained the nature and application of an instrument designed to measure it, dispensing with much difficult calculation by its use, and at the same time getting data more nearly accurate under working conditions. I have read with pleasure Mr. Hoadley's favorable notice of my work, and this, together with the fact that a leading English journal has reprinted in full from the American Machinist my first letter upon the subject, are a source of encouragement. These indications show with what importance the subject is impressed upon the minds of at least some of the leading engineers of the world.

It appears to me advisable, before treating the subject further, to go back to the beginning—the fountain head—and learn there the nature of this force. All physical forces have one common unit of measure, called the *force unit*. The force unit is such that if it act on one pound of matter one second will impart to it a velocity of one foot per second. Any force which sets a body in motion, causes it to continue moving, or brings it to rest, contains a definite number of force units. The resistance a body offers to being set in motion, accelerated in motion, retarded or brought to rest, is inertia, and is measured by the force required in putting the body in motion, accelerating its motion, or given out in retarding or bringing to rest in a given time. While a body is moving it is possessed of a stored energy, which is inertia, and by which it resists being brought to rest. While at rest it resists being set in motion by the same property. It is inertia also by which a body in motion resists a change in the direction of its motion, and this same inertia is what is called in a revolving body centrifugal force, simply from the fact that the body, in passing around the circumference of the circle, is continually being deflected from a straight line.

It is inertia which strikes the blow when one body comes in contact with another. It is inertia which causes the crushing in of vessels' hulls when they collide at sea. In this manner the inertia of bodies of passengers aboard ship contributes to their own doom. It is the force of inertia which, acting upon the sails, moves the vessel along. It is inertia which carries the railroad train to destruction, after the engine has been reversed and the brakes applied.

The more rapidly a body is set in motion or brought to rest, the greater must the force be. The greater the time required, the less the force or weight must be. The greater the force the greater must be the weight or velocity. The greater the weight, the greater must be the time or the less must be the velocity.

The following formula will be of future use:

Let F = force units.
V = velocity in feet per second.
T = time in seconds.
W = weight in pounds.
Thus:

$$1 \qquad \frac{W \times V}{T} = F.$$

$$2 \qquad \frac{F \times T}{W} = V.$$

$$3 \qquad W \times (V \div F) = T.$$

$$4 \qquad \frac{F \times T}{V} = W$$

These formulæ being very simple will require no explanation.

We have already learned that one force unit, when it has acted upon one pound of matter during one second, will have imparted a velocity of one foot per second, and that if it then ceased to act the body would go on forever at the rate of one foot per second, supposing it to be uninterrupted. If now the force unit act again upon the body during another second, it will impart to it an additional velocity of one foot per second, and it will be moving at the rate of two feet per second. Now, if the unit of force be reversed upon the pound of matter to arrest its motion, during the first second it will have reduced its motion to one foot per second, and during the second second will have brought it to a state of rest again.

The same force then is required to bring a body to rest as that required to set it in motion in a given time. It should also be borne in mind that the same force is required to accelerate a body any number of feet per second, or retard it the same number of feet per second, as that required to give the same body a velocity of that number of feet per second, or bring it to rest from that velocity in a given time.

Gravity will in one second impart a velocity of 32.16 feet per second, and, as the force unit will only impart $\frac{1}{32.16}$ of that velocity in the same time, gravity must equal 32.16 force units. One pound of matter, therefore, is drawn toward the earth with a force of 32.16 units.

From the above it is easy to calculate the force of the body in terms of its own weight, without knowing the weight.

EXAMPLE.

A body obtains a velocity of 20 feet per second in $\frac{1}{16}$ of a second. What must be the force required in terms of its own weight?

We have velocity and time as known quantities—required force.

Discarding W in formula 1, we have

$$V \div T = \text{Force}; \quad 20 \div \tfrac{1}{16} = 320,$$

which is the number of force units. Divide this by 32.16, and the quotient is 10, nearly, which is the force required in terms of the body's own weight. If that weight were 50 pounds, the force would be 500 pounds; if 200 pounds, the force would be 2,000 pounds, and so on. Then, to obtain the force in terms of the body's own weight, we have the following formula:

$$5 \qquad \frac{V \div T}{32.16} =$$

Force in terms of the body's own weight.

The *Railroad Gazette* of August 1 has information of the laying of 128¼ miles of track, making 1725 miles so far this year. The total track reported laid, to the corresponding date for thirteen years past is as follows:

	Miles.		Miles.
1884	1,712	1877	830
1883	2,761	1876	1,046
1882	5,473	1875	594
1881	2,924	1874	913
1880	2,525	1873	1,966
1879	1,187	1872	3,372
1878	941		

A Town Heated and Lighted by Natural Gas.

The town of Creighton, situated some twenty miles north of Pittsburgh, Pa., is unique in some respects, for the houses are lighted and heated exclusively with natural gas. Three years ago some capitalists conceived the idea that a flow of natural gas could be obtained in the valley of the Allegheny sufficient to run a glass manufactory, so they purchased land where Creighton now stands and proceeded to sink a well. A good coal vein was pierced, but they did not want coal, and kept going down, till at a depth of 1200 feet a body of gas was struck which burst upward with a force of 250 pounds to the square inch. This gave assurance of sufficient fuel, so the Pittsburgh Plate Glass Company was organized and works erected. Finding that there was sufficient gas to run the works and provide light and heat in the houses of the workmen and others that quickly grew up round the works, arrangements were made to supply all the houses with the gas, and this plan has been carried out. So there is to be witnessed, the spectacle of a growing manufacturing town with no smoke and no cinders around. The gas has come to be a great favorite in the households for cooking, heating and lighting purposes.

An English bicycle rider has been making calculations on the wear of bicycle bearings, and he thinks an incredible distance can be traveled on some of those machines without the bearings needing repairs. He had been riding a machine whose bearings were formed of steel rollers, so that the revolving parts did not slide but rolled over each other. He weighed the rollers carefully before starting on a long journey, and at the end of every 200 miles he cleaned and weighed them again. After traveling 1,000 miles each roller had only lost $\frac{1}{250}$ of a grain in weight. From this he concluded that the rollers would lose only $\frac{1}{4}$ of their weight in traveling a distance as far as from here to the moon. He made no allowance for the increased wear that follows the distortion caused by wear.

The *Ironmonger* publishes a table of British reports during June as compiled by the Board of Trade. The exports of steam engines and machinery to the United States during June this year was in value £30,969 as against £80,432 during June 1883. Up to July 1, 1883, the tariff on machinery was 40 per cent. Since that date it is 45 per cent. Although we have imported much less machinery this year than last, there has been no scarcity of machinery and prices have declined. In view of this result the "revenue reformers," who are aching to "reduce the surplus," by cutting down the tariff rate, better change their programme and move to advance it about ten per cent.

The inventors and makers of agricultural machinery have devoted so much ingenuity upon their work that it is hard to conceive any ordinary operation in farming that is not facilitated by some labor-saving machine. From the time that wheat goes into the ground till the time it reaches the table in the form of bread, nearly every separate process has been done by machinery. One part has, however, thus far puzzled inventors, and that has been the designing of a machine that would shock the reaped grain. This problem has now been grappled by Duncan McMillan, Macomb, Ill., who has patented a machine for shocking grain. So far as we can make out from the specification, the inventor proposes, by means of the proper machinery, to build the shock on the platform of a traveling machine, and then drop it on the field. We know of no field of mechanical enterprise where labor-saving appliances are receiving the same attention at present as they are in agricultural machinery establishments.

"A plan is proposed at Buffalo," says the *American Miller*, "to utilize the current of Niagara River to operate the machinery of the city water works. A portion of the Bird Island pier is to be used as the shore side of a raceway; and outside of this, and parallel to it, another pier is to be built. Between the two, movable wrought-iron frames are to be placed, holding as many wheels as may be necessary. We are told that the wheel proposed is ten feet in diameter, and somewhat different from the ordinary turbine."

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NEW YORK, AUGUST 23, 1884.

CONTENTS.

	PAGE
Parallel Instantaneous Grip Vise	1
Poison in Soda Water Fountains	1
Dangers of a Mountain Railroad	1
Brakes on the Elevated Railroads of New York	2
Early Engineering Reminiscences. By George Escol Sellers	2
Brooks Locomotive Works	2
Foundry Cranes. By Thomas D. West	3
American Water Works Association	3
Fire in the Baldwin Locomotive Works	4
Mechanical Protection for an Open Drawbridge	4
Demand for Smoke Consuming in Chicago	4
Farmers' Friend Wire Stretcher	4
Letters from Practical Men—The Hardening and Contraction of Steel—Dead True Surfaces for Iron Planes—The Perfect-Screw Problem—Rod Brasses made Practically solid—Cleaning Boilers—Melting Steel in an Ordinary Cupola—	4, 5
Boiler for Steam Heating	5
Soldering Aluminum	6
Tests of the New Cruisers' Boiler Sheets	6
The Indicator Diagram. By F. F. Hemenway	6
An Italian Locomotive	6
A Mexican Cotton Mill	6
The Brown & Sharpe Universal Cutter and Reamer Grinder	7
Inertia—its Nature and Means of Measurement. By Ed. F. Williams	7
A Town Heated and Lighted by Natural Gas	7
American Machinists	8
Restoring the Strength of Case-Hardened Iron	8
Three Miles or More a Minute	8
Literary Notes	8
Questions and Answers	8
Manufactures	9
Machinists' Supplies and Iron	10

American Machinists.

The machinist trade in America developed under conditions different from those that accompanied the growth of the trade in older countries. Our early machinists were little hampered by the outcome of guild restrictions in learning the trade. As the call for crude machinery arose, blacksmiths and wheelwrights formed partnerships to do what may be called millwright work. The men employed in such establishments shared the run of the work. One day a man would be working at the anvil hammering out an ax; next day he might be working on the pattern of a cog-wheel, or repairing a bursted pump, or turning a saw arbor. The rapid improvement in machinery that accompanied the application of the steam engine to transportation produced a demand for men capable of doing machine work, and handy blacksmiths, wheelwrights and millwrights recruited the machinist ranks. Any man or youth who had a taste for mechanical work was welcomed in the trade, whatever may have been his previous occupation. If a youth entered the trade and found he had mistaken his vocation, he could easily withdraw, for no traditions of the craft made it an act of disgrace to withdraw from the business. Only one requisite was essential to success—that of self-reliance as a workman. The colonial attribute of self-reliance impressed itself strikingly upon the early generations of American mechanics, and they retain the attribute as a class to-day. This is to be seen in the capability our machinists have of working along without continual supervision of a foreman. They are proud of their ability to direct themselves, and, as a rule, can be depended on to work faithfully when the foreman's back is turned. Other nations may have closer workmen, with more delicate touch of hand than ours, but no other country's mechanics bring the combined power of skill and intelligence into their work that American artisans do. To their peculiarity of thinking, while working, may be traced the origin of some of our greatest mechanical triumphs. The ingenuity cultivated by this habit fills our Patent Office with the records of useful inventions and improvements devised by working mechanics.

When a European workman offers to suggest improvements in established machinery, or proposes to depart from the formal routine of doing work, his originality is generally rewarded with the information that he is paid for working according to directions, not for thinking. He accordingly develops accuracy of hand by repeating operations after an established method. He does not attempt to invent a labor-saving tool or an improvement on the manner of producing work, because he finds no encouragement to try anything of the kind. Our workmen, on the other hand, are encouraged to use their brains, and the best jigs and labor-saving devices used in our shops have been invented by the mechanics who use them. This system is developing the constructive skill of the country, and so intelligence among our workmen is pushing America to the front of industrial nations.

A correspondent complains that we refer him, in answer to a question, to a back number of the AMERICAN MACHINIST which he does not happen to have. We think the complaint is not well considered. We frequently refer questions to some previous issue, mainly because in justice to regular readers we cannot, as a rule, repeat matter previously published. Sometimes the reference is to matter occupying considerable space, and answering the question much more fully than we could do in the limited space devoted to that purpose. In the instance of which our correspondent complains, the reference was to matter occupying nearly a column, illustrated with an engraving. To reproduce would be expensive and would be an infliction upon the majority of our readers, while our correspondent can obtain the paper to which he was referred from any newsdealer for the small sum of five cents. We believe upon consideration he, and others, will see the matter as we do.

Restoring the Strength of Case-Hardened Iron.

In a recent issue we published a short note detailing some experiments on the strength of case-hardened iron, going to show that the iron was seriously weakened by the operation.

With reference to this, Professor John E. Sweet writes us as follows: "The article in your issue of August 16, regarding the experiments made at the Baldwin Locomotive Works on case-hardening iron, would appear to have settled the question in regard to the weakening effect of the case-hardening process. But they have stopped far short of what can be done. If they will take the trouble to repeat the experiment, case-harden the work as before, then anneal it as they would hardened steel, and then heat and harden, they will find the experiment tells altogether a different story, or prove that good Norway iron behaves differently in Philadelphia than in Syracuse."

We believe Professor Sweet is quite right in the above, and should be glad to hear of experiments in the manner indicated, with the results so far as affecting the strength is concerned. The matter is not so generally understood as it should be, and, since the value of case-hardened surfaces is undisputed, any information on the subject is of undoubted importance.

Three Miles or More a Minute.

Under this heading, a practical mechanic, who is a maker of a good machine tool, sends the description of a locomotive engine which he feels confident will pull a train at a speed of three miles a minute or more. He claims that the scheme is nothing visionary, but sound and practical, every detail having been subjected to careful scrutiny, and considered out by a man whose business gives him intimate acquaintance with the nature of metals.

The details of the scheme call for a monster track of nine-feet gauge, with curves no shorter than 3,000 feet radius, and no grades heavier than 27 feet to the mile. There would be three rails resting on metal ties. A sketch of the proposed locomotive is given, which indicates a departure from established practice no less radical than the proposed track. Two trios of driving wheels, 24 feet diameter, are to be operated from cylinders placed between the wheels, and we infer from the sketch that it is proposed to work two cranks from one piston. All the other parts of the engine are large in proportion with the driving wheels. The proposer of this advance in methods of traveling supposes that many of our readers will laugh at the scheme and caricature the man who presents it as an idiot, yet he does not feel that such want of appreciation should discourage him.

Some manufacturers and business houses receive by mail so many so-called "trade papers" that they do not patronize in any way, and do not ask to have sent to them, that it becomes quite a problem to know what to do with them. Most of them come regularly every issue from the office of publication. A hardware manufacturer once told us that he received enough free papers to pack around the goods in every box shipped from the factory. We learn from *Building* that a new use for superfluous newspapers has been discovered. It seems to offer a good way to dispose of gratuitously mailed trade papers, and we quote it as found:

A very complete filling for open cracks in floors may be made by thoroughly soaking newspapers in a paste made of one pound of flour, three quarts of water, and a tablespoonful of alum, thoroughly boiled and mixed; make the final mixture about as thick as putty, a kind of paper putty, and it will harden like papier-mache.

Literary Notes.

Since general railroad building has become quiet, the laying of tramways or street railroads has become somewhat brisk, especially in Texas and other parts of the South. In new and growing towns of sufficient population street railroads usually prove profitable, and capitalists are turning their attention towards such investments more than they formerly did. There are some hundreds of tramways in the United States. The only full directory of these roads, that we have ever seen, is in the *National Car Builder Supplement*, just published by the *National Car Builder*, 140 Nassau Street, New York. They are arranged alphabetically by towns, and the directory not only gives the names of the officers of the companies operating the roads, but also the length of road, its gauge, weight of rail, and number of cars and horses, in most instances. The *Supplement* also contains similar information of the street railroads in South America, Mexico, and the West Indies. It also contains directories of the car manufacturers, axle manufacturers, locomotive builders, car wheel and car spring manufacturers in the United States and Canada.

A new paper-mill directory has a record of 1,085 paper and pulp mills in the United States, twenty-seven of which are not in operation. New York has 257, and Missouri only one.

QUESTIONS AND ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials, nor location will be published.

(318) G., Baltimore, Md., asks: Do the slide valves of a locomotive engine rise off their seats when the engine is running reversed? *A.*—At a certain part of the stroke the valve is raised. The subject is treated in detail in our issue of April 5, page 3.

(319) R. R., Sutro, Nev., asks: 1. Is it possible to affect an iron bridge or similar structure so as to destroy it, by means of a violin or other stringed instrument? *A.*—No. 2. Is there anything ½" thick, or less, that, if placed between a magnet and a piece of steel, will destroy the action of the magnet? *A.*—Nothing that we know of.

(320) H. F., Port Chester, N. Y., writes: 1. Which would be best, for a 36" cupola, two or four tuyeres? *A.*—For an ordinary cupola, four. 2. We have a blast pressure of six ounces. Is that right? *A.*—Six ounces is a very common pressure. The best blast pressure will depend something on the construction of cupola. Some will work satisfactorily with this pressure, others will work better with eight ounces or more.

(321) J. M., Brooklyn, N. Y., writes: I have a machine with a 6" pulley, the surface speed of pulley being 560 feet a minute. If I put a weight on the face of pulley, it takes 20 pounds to move it. I figure the power as follows: $\frac{20\times560}{33000}=\frac{11}{33}$ horse power. Is that right? *A.*—No. It would undoubtedly require more than 20 pounds to turn the pulley when up to speed.

(322) M. C., Claflin, Me., asks: 1. What is the horse-power of an 8"x20" engine, cut-off at ⅝ stroke? *A.*—It may be one or twenty-horse power, according to speed and steam pressure. 2. What is a good paint for locomotive smoke stacks? *A.*—See answer to Question 88, March 1, 1884. 3. What is good for cleaning brass? *A.*—See answer to Question 333, September 30, 1882. 4. When we have 26" vacuum, is it equal to 26 lbs.? *A.*—26" vacuum is equal to about 12¾ lbs. per square inch. 5. Instead of putting water in at the bottom of a boiler, why would it not be as well to put it in a little above the bottom? *A.*—It is as well.

(323) ——, San Francisco, Cal., asks: What is the friction, in pounds, of water in a 12" pipe 40,000 feet in length, the velocity of water being 10 feet per second? *A.*—A formula derived from Weisbach is: Friction head in feet=

$$\left(.0144+\frac{.01746}{\sqrt{v}}\right)\times\frac{l}{d}\times\frac{v^2}{5.4}$$

In this l=length of pipe in feet, d=diameter of pipe in inches, and v=velocity of water in feet per second. Applying this to your example, and—

$$\left(.0144+\frac{.01746}{\sqrt{10}}\right)\times\frac{40000}{12}\times\frac{100}{5.4}=1228,$$

the friction head in feet; and $\frac{1228}{2.311}=531$ lbs.

(324) C. L., New York City, asks: 1. How can I calculate the gain by using a feed-water heater? *A.*—Baldwin, in Steam Heating for Buildings, gives the following simple rule: "Divide the difference between the temperature of the cold water as it enters the heater and that at which it enters the boiler into 1146 less the difference between the cold water and 32, and the product is the fraction of the coal heap." Take, for example, temperature of water that enters heater 60°; temperature of water entering boiler 200°; then 200−60 =140, 60−32=28, 1146−28=1118 and 140+1118=12.5 per cent. saved by the use of heater. 2. Can a slide valve be made to cut-off equal on each end, and at the same time have equal lead? *A.*—Not as ordinarily constructed.

(325) D. E. S., Philadelphia, Pa., asks: 1. How much power will a 7″ belt transmit, running from a 36″ pulley on main shaft which makes 310 revolutions per minute, to a 16″ pulley on countershaft; also a 6″ belt, running from a 22″ pulley on this countershaft to an 8″ pulley on machine? *A.*—There are many conditions not noted that would influence the amount of power that could be transmitted; probably about 20-horse power in both instances. 2. What horse-power is required to drive a shaving exhauster made by the Boston Blower Company and designated "45," at a speed of 2,000 revolutions per minute? *A.*—We refer you to the company named, who will doubtless be glad to give you the desired information. 3. What will be the gain in horse-power by applying a condenser to a non-condensing engine, the vacuum being 26″? *A.*—From 20 to 30 per cent., depending on circumstances. 4 Can I rely on the correctness of a steam-engine indicator? *A.*—Yes.

(326) Inquirer, ——, writes: My friend and myself differ on a question which may be stated thus: A wire rope is stretched from two points, 84 feet apart, and a weight at the center of 1,000 lbs deflects it 2 feet from a straight line. What is the pull at the two points from which the rope is stretched, due to the weight at center? My friend claims that it is 2,100 lbs. on *both* points. I think it is less. Which is right? *A.*—Both of you are far

from right. The little sketch shows how you may determine how much the 1,000 lbs. will pull at the two points. Thus draw the lines *a b*, *b c*, on as large a scale as possible, deflected (by the same scale) 2 feet at the center. Then complete the parallelogram by drawing the line *a d* parallel to *b c*, and *d c* parallel to *a b*, also draw the diagonal *b d*. As much greater as the distance *a b* or *b c* is than the distance *b d*, so many times 1,000 lbs. will the strain at *a* and *c* be.

(327) J. C. R., York, Pa., asks: 1. Can you give me a rule for determining how much steam will be condensed from boiler to engine? *A.*—No. 2. Is there any way to set a tool at any desired angle if the head is not graduated? *A.*—You can do it by the use of a bevel, sometimes called a bevel square. 3. What is the meaning and what the advantage of a high and what of a low-pressure engine? *A.*—An engine that exhausts into the atmosphere is frequently called a high-pressure engine, and one with which a condenser is used, a low pressure. As thus spoken of, the advantage of the low-pressure engine is in having the pressure of the atmosphere removed from the piston. You will understand this better by reading some elementary work on the steam engine. 4. At what point should an engine cut off, and how can the valve be set to cut off at any point? *A.*—No general answer to this question can be given. The cut-off is made earlier or later, according to various circumstances. Generally speaking, the point of cut-off is provided for when the engine is built, and you cannot, or should not, alter it by setting the valve.

(328) J. H. C., Rosehead, Ill., asks: Will you give me the size of holes to be drilled for U. S. S. taps, to tap a full hole? *A.*—We find this given, as follows, in Nystrom's Mechanics:

Diameter of Screw.	Thread per Inch.	Diameter of Core.
¼	20	.185
5-16	18	.240
⅜	16	.294
7-16	14	.344
½	13	.400
9-16	12	.454
⅝	11	.507
¾	10	.620
⅞	9	.731
1	8	.837
1⅛	7	.940
1¼	7	1.065
1⅜	6	1.160
1½	6	1.284
1⅝	5½	1.389
1¾	5	1.490
1⅞	5	1.615
2	4½	1.712
2¼	4½	1.962
2½	4	2.175
2¾	4	2.425
3	3½	2.628

(329) A. C., New York, writes: 1. In calculating the contents of a cask or tank, I have been allowing 231 cubic inches to the gallon. Is that right? *A.*—Yes. 2. About what space will a ton (2,240 lbs) of pea coal occupy? *A.*—Pea coal varies in weight, according to quality. We believe it will weigh between forty and fifty pounds per cubic foot. 3. In getting the clearance of a steam engine cylinder, suppose, for instance, the distance between the piston and cylinder-head is 5/16″ and the diameter of cylinder is 24″, what is the clearance of that part? *A.*—Multiply the area representing the diameter by the distance. Thus, if the diameter is 24″ the area is 452.4 inches, and this multiplied by 5/8 would equal 282.7 cubic inches. 4. How shall I get the clearance due to ports? *A.*—Multiply together the three dimensions of ports, precisely as to find the cubic inches in a solid body. It is frequently difficult to measure the dimensions of ports, and the counterbore of the cylinder is generally larger than the nominal bore. You will find a good plan for determining the clearance in a cylinder explained in a communication from Professor Sweet, in the AMERICAN MACHINIST of June 23, 1883.

(330) J. R., ——, asks: 1. Why are the strains on the longitudinal seams of a boiler double those on the round-about seams, and why are the longitudinal seams double riveted? *A.*—Assume a boiler 96″ diameter, ½″ iron, under 100 lbs. pressure. The pressure to rupture it horizontally will be 96x100=9600 lbs., borne by two sections of iron, altogether one inch of metal. The pressure to pull the boiler apart in the direction of its circumference will be the area multiplied by the steam pressure, that is 7238 24×100=723824 lbs. The circumference of the shell is 301.59″, which, divided by 2 (the iron is ½″ thick), gives 150.79″ of iron to stand this strain. This is 723824÷150.79=4800 lbs. per inch. It is for this reason that the longitudinal seams are double riveted. 2. Why will a piece of steel in the form of a triangle give a better sound than a straight bar? *A.*—Using the same length of steel in both cases, we do not know that it will. 3. Why in a one-ended link will the cut-off be shorter when the block is moved to increase the travel? *A.*—We suppose you mean when the link is used to cut-off, with a valve separate from the main slide, in which case it will depend on the arrangement of the valves. You will see, by a little reflection, that with the cut-off valve on the back of main slide, the arrangement may be such that increasing the travel will cut off steam earlier in the stroke. 4. Is it possible that stone, iron, or similarly heavy substances will be borne up by the water after sinking to a certain depth? *A.*—No. 5. What proportion does the length of an indicator diagram bear to the stroke of the engine? *A.*—Not necessarily any. The diagram is of any convenient length, to suit the taste of the one who takes it. 6. Please explain how electricity is made to act as a propelling power. It is all Greek to me. *A.*—Since you do not understand anything of the subject of electricity generally, it would be useless to try to explain in the space we could use. If you will read any modern school-book on philosophy you get a fair idea of the subject, then you can study it further in more advanced works.

BUSINESS SPECIALS

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Mackenzie Cupolas and Blowers, 245 Broadway, N. Y.

Presses & Dies, Ferracute Mach. Co., Bridgeton, N. J.

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

Rotary Files, Tower M. Works, E. Brookfield, Mass.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 86 John street, N. Y.

Crists' high-speed compound engines. Crist Engine Works, 182 Centre st., N. Y. Send for circular.

Herbert W. T. Jenner, Mechanical Engineer and Solicitor of Patents, 632 F st., Washington, D. C.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Foot Power Machinery, for workshop use, sent on trial if desired. W. F. & John Barnes, Rockford, Ill.

The latest Improved Tack and Match Machinery is made by White Machine Co., Waterbury, Conn.

Consulting Engineer and Mechanical expert, C. C. Hill, 84 Market street, Chicago, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

National and box chucks, foot and power lathes, and slide rests. Lodge, Barker & Co., Cincinnati, O.

DRAWINGS—Mechanical, electrical and Patent Office. All styles of artistic designing. Special facilities. Low rates. Wallace Metcalf, 140 Nassau St., N. Y.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Improved Tack Machinery, made by The Willets Man'f'g Co., can be seen in operation at their works, 57 Clifford St., Providence, R. I.

Split Pulleys at low prices, and of same strength and Appearance as Whole Pulleys. Yocom & Son's Shafting Works, Drinker St., Philadelphia, Pa.

The "Wax Process" Engravings shown in the AMERICAN MACHINIST each week are made by Struthers, Servoss & Co., 32 Frankfort Street, N. Y.

Engine Lathes, Hand Lathes, and other fine tools. Assortment large; prices low. Frasse & Co., 62 Chatham St., N. Y.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

EXTRACTS FROM CHORDAL'S LETTERS, 400 pages, 12mo., handsomely bound in cloth. New and enlarged edition, with over 50 illustrations. Price $2. Published by John Wiley & Sons, 15 Astor place, New York.

For a strictly first-class automatic engine, from 10 to 60-horse power, apply to the Straight-Line Engine Company, Syracuse, N. Y.; medium or high-speed; perfect balance; fewest parts and fewest working joints; uniform speed at all ranges of power or steam pressure; the best material and workmanship in all vital parts; the most correct distribution of iron; unexcelled in smooth running.

MANUFACTURES

Owensburg, Ky., is building its $400,000 cotton factory.

Several stove works in Ohio have shut down, to work off surplus stock.

Buchanan & Trawick, Opelika, Ala., are building a cotton-seed oil mill at that place.

The Texas and St. Louis Railroad machine shops, at Tyler, Texas, are to be enlarged.

Hampeter & Eckhoff, St. Louis, Mo., will erect a three-story furniture factory to cost $7,000.

Quite a number of starch factories are to be erected in Maine, during the coming season.

Thomas Cornell, 1815 North Sixth street, Philadelphia, will erect a two-story shop 31x100 feet.

A cotton factory is to be built at Yazoo City, Miss, by Philip Marshall & Co., to cost $600,000.

The immense stove works of Sherman S. Jewett & Co, at Buffalo, N. Y., have closed for an indefinite period.

A new cotton mill is to be built by Craven & Dearnley, of Philadelphia, on Eighth street, above Somerset.

Carpenter & Sons, Lincolnton, N. C., are to extend their cotton-mill buildings and nearly double their machinery.

Ground has been broken in Augusta, Me., for the erection of the Edwards Manufacturing Company's new cotton mill.

The Pennsylvania Steel Company, of Steelton, Pa., will discharge any employe who is known to be drunk or disorderly.

The Concord (N. H.) Machine Works recently shipped a full line of machinery to Australia, to equip a horse-car manufactory.

Lincoln, Neb., will issue bonds to the amount of $90,000, the proceeds to be devoted to the construction of a system of water works.

The removal of the Texas and Pacific shops from Sherman to Bonham, Tex., adds about five hundred to the population of the latter place.

E. M. Hallowell, St. Paul, Minn, will erect a $14,000 building, for a carriage manufactory, in that city, between Ninth and Tenth streets.

The Knoxville Foundry and Machine Company, Knoxville, Tenn., are enlarging their works, and will put in considerable new machinery.

The Chicopee Manufacturing Company, Chicopee Falls, Mass., will at once commence work on the new 200-foot extension to their cotton mill.

Bishop & Babcock, Cleveland, O., manufacturers of beer pumps, have recently started ten tack machines, and will soon have ten more running.

The Eureka Cotton Gin and Corn Mill Manufacturing Company, Palestine, Texas, is a new corporation that has begun to erect a large manufactory.

The Birmingham Novelty Works Company, Birmingham, Ala.—capital $10,000—have just started up for making iron castings and hardware specialties.

The Hendey & Meyer Engineering Company, Denver, Col., is to manufacture the 100-horse power engine that is to drive the machinery at the Denver Exhibition.

The Crist Engine Works, 182 Center street, New York, have been fitted up to build the Crist high-speed engine, which was illustrated in our issue of May 3, 1884.

The State Normal School building, to be erected on Willett street, Albany, N. Y., will cost $145,000. Sullivan & Ely, of that city, have the contract for the iron work.

The carpet trade in Philadelphia has increased fifty per cent. in the last four years. That city makes more blankets and more carpets than any other city in the world.

Newark, N. J., will probably contract for large sewage-pumping machinery. The present method of disposing of the sewage by drains, into the bay, does not prove satisfactory.

The Gloucester Net and Twine Company has been organized at Gloucester, Mass. Ground has been broken for its manufactory, which, it is expected, will be in operation in October. Boston office, 96 Commercial street.

The Haydenville Manufacturing Company, has been chartered at Haydenville, Mass., having A. T. Foster for president and George L. Strong for treasurer, for the manufacture of machinery and plumbers' materials. Capital $150,000, in 150 shares.

Fay & Scott, Dexter, Me., are about finishing up a lot of eleven small engine lathes, which they have made for N. Dustin & Co., who are making for them a large lathe which they will put into their machine shop. The most of these small lathes will be used by the Dustins in their own business, and will be put in place of the machinery to be taken out by Fay & Scott when their lease expires. The Dustins will then add quite a number to their crew.—*Eastern State.*

Messrs. Ostrom & James, two gentlemen representing Northern capitalists, have purchased the water power at the head of the San Marcos river, Texas, from Fourqueran & Code. The price paid was $18,000. It is understood they will immediately construct and put into operation a $200,000 paper mill.

The Pennsylvania Railroad Company have purchased 120 acres of land at Freedom, Pa, from John Conway for $104,000. It is their intention to erect upon it shops, round-houses, etc., and make up all the East and West-bound freight trains at that point.

A $500,000 cotton mill is projected for Birmingham, Ala. G. W. C. Lomb, of that place, has made arrangements with New York capitalists, whereby it is proposed that if the people of Birmingham will raise one-half the amount the New York parties will furnish the balance.

Lambert, Harris & Co. have a wagon factory at Avis, Augusta county, Va. They will get up a joint stock company and build a new and larger factory at Roanoke, Va., and move their machinery to the latter place. The citizens of Roanoke have offered inducements to them to move.

D. W. Rodgers & Co., Renfroe, Ala., are spending about $100,000 in building their saw, planing, and shingle mills. They will establish a system of works to convey water to the village, and contemplate erecting an iron furnace after their mills are finished.—*Baltimore Manufacturers' Record.*

The Buffalo (N. Y.) Forge Company are building an addition to their foundry 75x182 feet in extent, which will double their capacity in this department. They also intend shortly to enlarge their factory by the erection of a building 50x125 feet, two stories in height, to accommodate a new line of business.

The Blair Manufacturing Company, of Springfield, Mass., has been incorporated with a capital of $40,000, for the manufacture and sale of lawn-mowers and other machinery. The corporators are Jas. S. Blair, president; William S. Baxton, treasurer; James C. Kenyon, and others. This company takes up the business long carried on by the Blair & Fiske Manufacturing Company.

The Standard Tool Company, Cleveland, O., have completed their preparations to manufacture twist drills, and by the first of September will have a complete assortment of taper-shank drills. They have fifty-five hands at work. The services of five experts have been secured by them, with W. A. Babcock, of Bishop & Babcock, as general manager. They are now furnishing twist drills from No. 80 to ½″.

John Rieppel, inventor of Rieppel's boiler-drilling machine, which was illustrated in the AMERICAN MACHINIST, September 1, 1883, writes us from Gaines, Pa.: "My business here is good, and I have all I am able to do with five men. By-and-bye I expect to manufacture small engines, up to 10-horse power. If you could get up a dispute about turning shafting, without gauging, to exact size and fast, I think it would do me and others some good." His drilling machine is made by the L. B. Flanders Machine Works of Philadelphia.

The *Western Manufacturer*, of Chicago, says: "The Wood-workers and Machine-hands' Union, of this city, at a recent meeting, elected officers for the ensuing six months, but their names are withheld from publication for prudential reasons. The question of forming an international union of wood workers and machine hands was discussed, and it is believed that such an organization will be effected early in the coming autumn." This union of "wood workers and machine hands" (the word machinists was probably avoided for a good reason) will no doubt be a unique organization.

The *Industrial World* says: The Chicago Screw Company's new works, to be erected at the northwest corner of Green and Fulton streets, next spring, will be of brick, 175 feet on Fulton and 150 feet on Green, and five stories and basement in height. An additional building will be constructed for engine and coal room, etc. Power will be given by a 150-horse power engine and a battery of four boilers. The company is building its own special machinery, which, together with the other machinery, will be placed in the new establishment. The capital stock of the concern will be increased in the spring to $200,000. The cost of the new works is estimated at $75,000, and that of the entire plant $200,000.

Director-General E. A. Burke has accepted the following proposals to furnish engines for the World's Exhibition at New Orleans:

	No. Engines.	No. H. P.
Cummer Engine Company	1	180
Cummer Engine Company	2	300
W. A. Harris	1	650
W. A. Harris	1	150
E. P. Allis & Company	1	500
Brown Engine Company	1	400
Robert Wetherill & Co.	2	600
Armington & Sims Engine Company	4	500
Westinghouse Machine Company	2	400
Taylor Manufacturing Company	1	200
Smith, Meyer & Schnier	1	200
Novelty Iron Works	1	200
Buckeye Engine Works	1	125
E. M. Ivers & Son	1	100
Lane & Bodley	1	75
Jerome Wheelock	1	280
Hooven, Owens & Rentschler	1	500
Total	23	5,360

The Pittsburgh Bessemer Steel Company are gradually remodeling their mill to the system of independent power. Their rail-straightening machine, which has heretofore been driven by a train of gears from the main engine, at great inconvenience from wear and breakage, is now driven independently by a 30-horse power Westinghouse engine.

Machinists' Supplies and Iron.

NEW YORK, August 7, 1884

The situation of the supply trade remains practically unchanged since last report was made. Business has not improved any and dealers do not talk in a hopeful strain of the prospects for the fall trade. The leading cause of the continued stagnation of the supply business seems to lie principally in the persistence with which railroads refuse to buy anything not needed for immediate wants.

Iron—The American pig market has slightly improved during the week. Furnacemen and dealers say that more inquiry has been made than what has been experienced for months. The market has presented an animated appearance, but buyers continue to take merely small lots, enough to supply current wants. This has prevented the volume of business from showing any material increase. The supply appears to be slightly in excess of requirements, but is not burdensome to carry. Standard brands of No. 1 X Foundry are quoted at $20, at tide-water, but may be bought for slightly less money. No. 2 X Foundry, $18 to $19; Grey Forge, $16 to $17.

Scotch pig—The market has ruled quiet, and about steady. We quote Shotts, $21.50 to $21.75, to arrive; Coltness, $21.50 to arrive; Glengarnock, $20.50, to arrive, $21.50 yard; Summerlee, $20.50; Cambroe, $20.50; Dalmellington, $19.50.

Steel rails, as so many other lines of mechanical business, are directly influenced by the condition of the steel rail trade, we made careful inquiries at some of the leading makers to ascertain how the prospects are. The words of encouragement heard were very few. Makers assert that they are selling steel rails at a loss when the price goes below $30 per ton, but that it is better to lose a little than shut down. There seems to be an impression among steel makers that little improvement in the price of rails will be experienced till next year.

Antimony—The demand for regulus has been slow, with sales made at concessions of price. The nominal quotions are, Hallett's, 10¼c.; Cookson's, 10¾c.

Copper—The market for ingot has undergone no change. Lake, is selling for 14c., and other Western brands for 13c. to 13¼c.

Lead—The market for common pig has ruled dull, with sales for late August delivery at 3.60.c.

Spelter—There have been sales of car lots of Western at 4¼c., and further supplies are offered at 4.55c. but the demand is sluggish.

Tin—The market for spot has been irregular, through the non-arrival of expected cargoes. We quote for jobbing lots, Banca, 20¾c.; Straits and Malacca, 18.50c. to 18.90c.

WANTED

"Situation and Help" Advertisements, 30 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—First-class mechanic, on fine, light machinery. Joseph Boyer, St. Louis, Mo.

Wanted—A situation, by machinist and draughtsman. Holds first-class English certificate for practice and theory. O., 307 N. Orchard st., Chicago, Ill.

An experienced mechanical draughtsman, on general, special, and tool work, desires a position. Can furnish references as to ability. Address Box 9, AMERICAN MACHINIST.

Wanted—Situation as foreman boiler maker, 18 years practice, young man, steady, and understands all parts of the trade. Address John Haney, 7 Borver street, Providence, R. I.

Wanted—Foreman for a boiler shop, in a Western city; must understand laying out all kinds of boiler and sheet iron work. References must accompany application. Address D., care AM. MACHINIST.

A mechanical engineer, draughtsman, and supt. with 20 years' experience—steam engines, sugar and refrigerating machinery, both compression and absorption specialties, is now open to an engagement. Best of reference. Address "20 Years," AM. MACH.

Wanted—A first-class foreman, for engine and jobbing shop, fifty miles from Pittsburgh, Pa., employing forty hands, building steam engines and boilers and general jobbing. Address "Foreman Machinist," AMERICAN MACHINIST, giving reference, experience, and salary expected.

Wanted—An energetic foreman, for our foundry. Must be well up in railroad, machine, and house castings. Only sober, reliable, and intelligent men need apply—stating age, price, and qualifications—with references, to Marshall Car-Wheel and Foundry Company, Marshall, Texas.

Wanted—A reliable firm in every city, to sell on commission the "Loftus Automatic Injector." Send for circular. Peter Kinnear, 66 Beaver street, Albany, N. Y.

Wanted—Parties traveling and selling to steam users, or dealing in mill supplies, to take the agency of a good and fast-selling article. Good inducements offered. Address "Manufacturer," care of AM. MACHINIST.

TABLES OF SPEEDS.

Tables of the principal speeds occurring in mechanical engineering, expressed in mètres in a second. By P. Keerayeff. Translated by Sergius Kern. Price, 20 cents. Descriptive catalogue of books, 100 pages, free.

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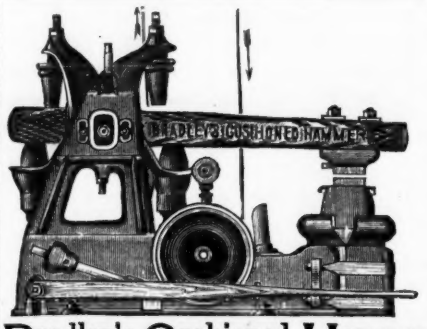

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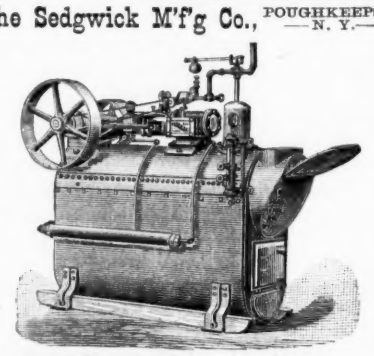

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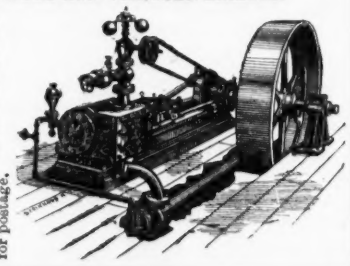

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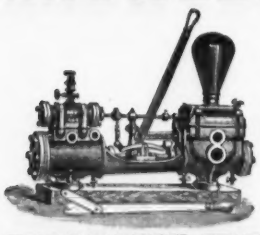

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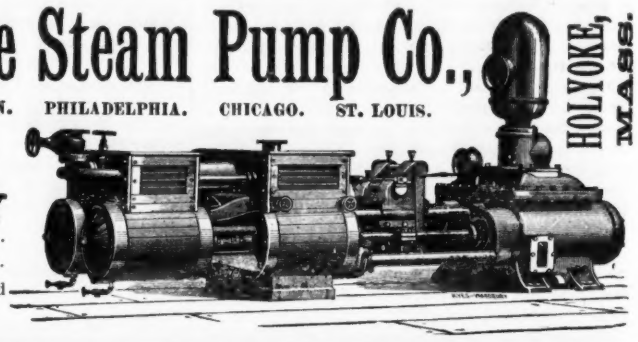

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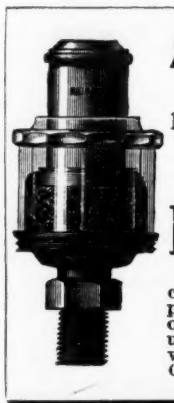

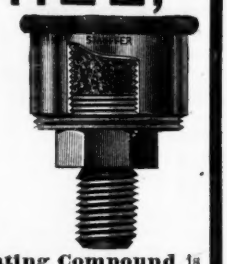

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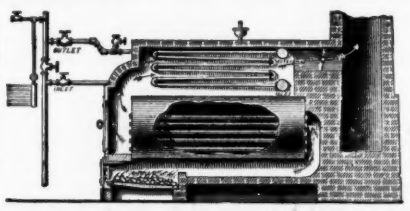

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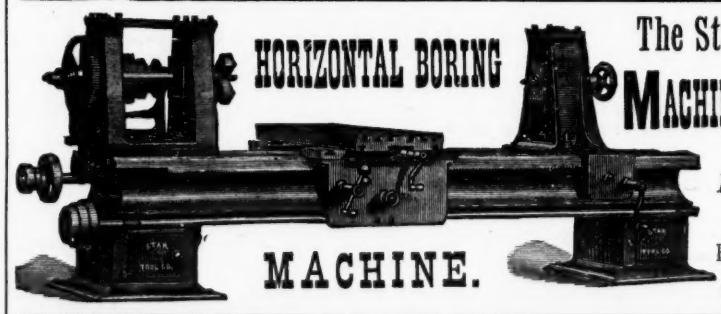

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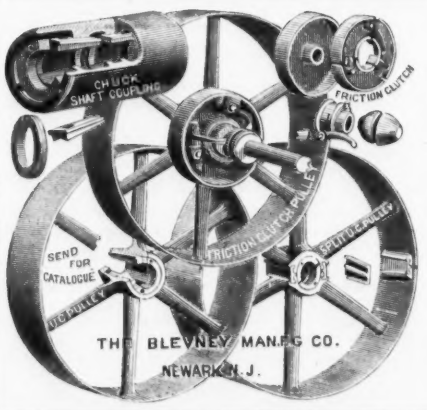

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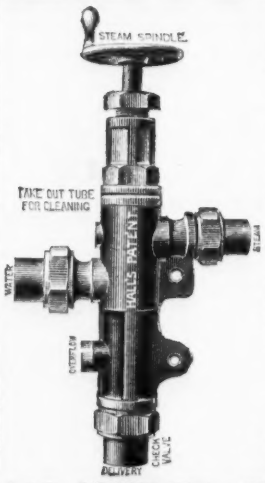

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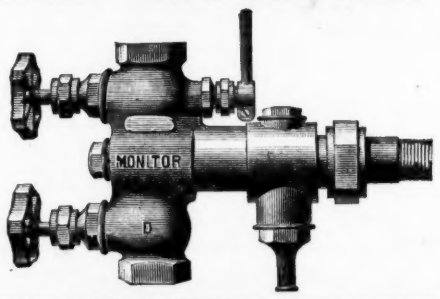

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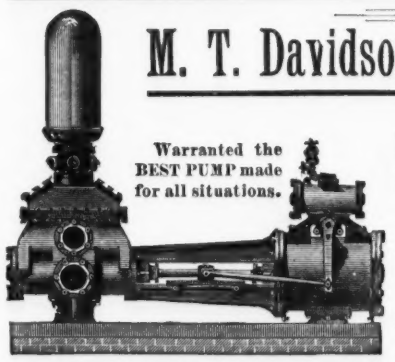

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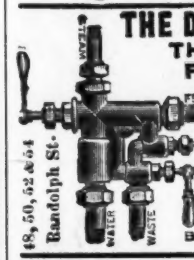

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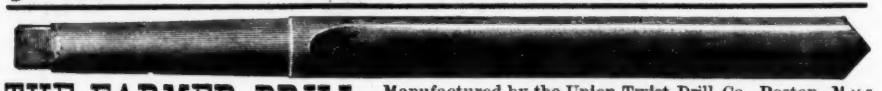

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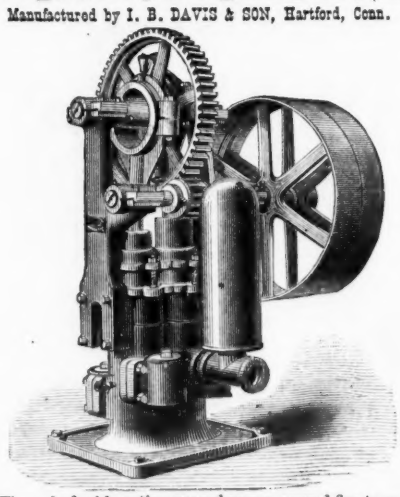

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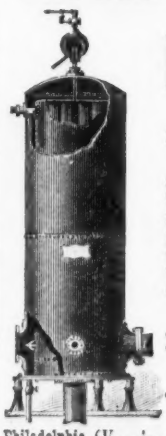

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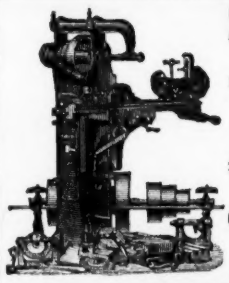

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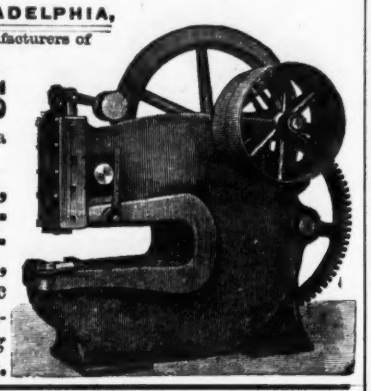

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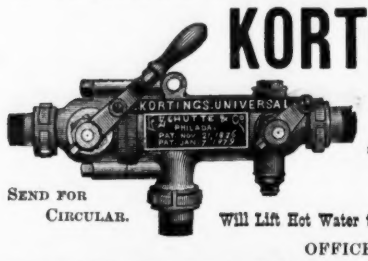

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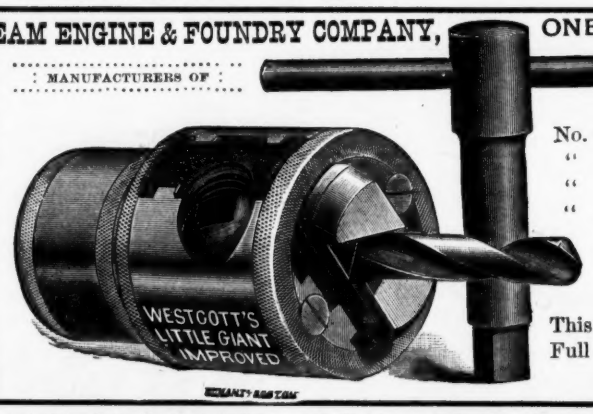

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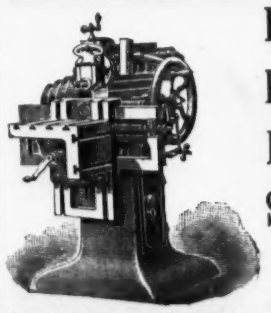

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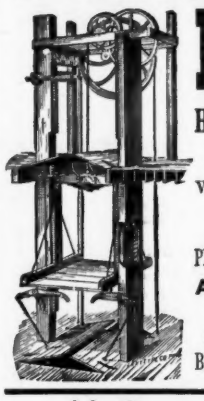

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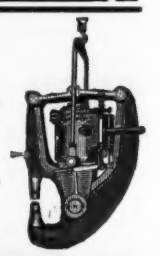

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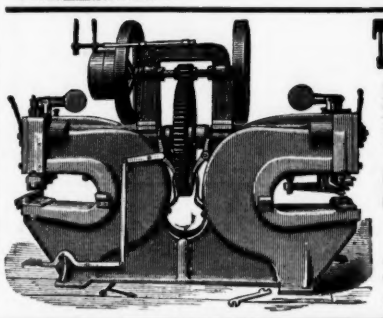

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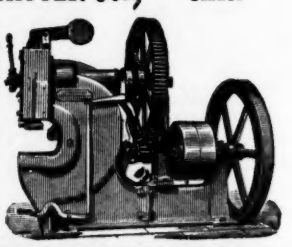

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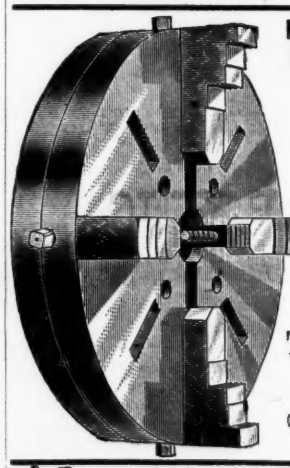

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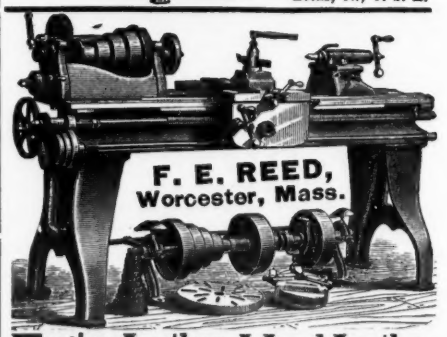

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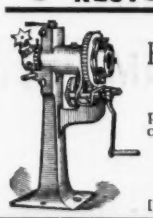

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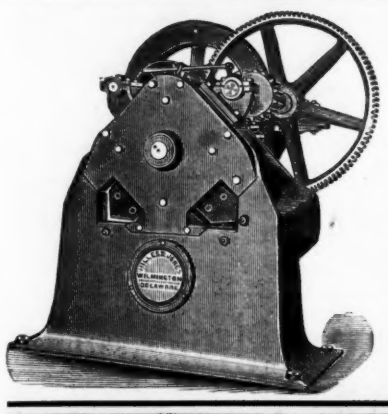

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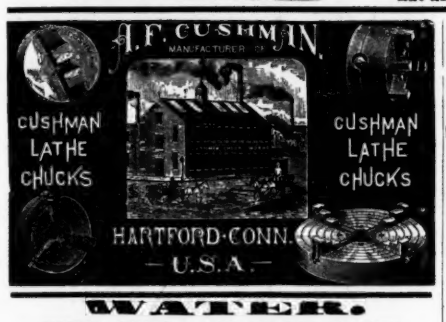

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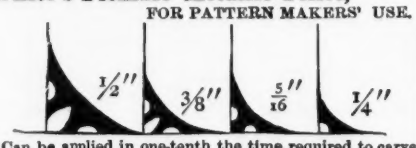

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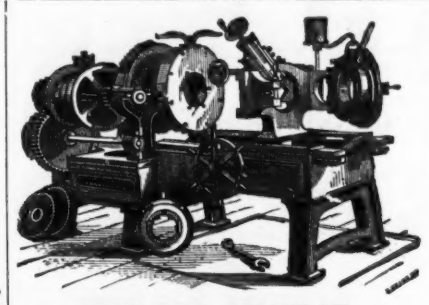

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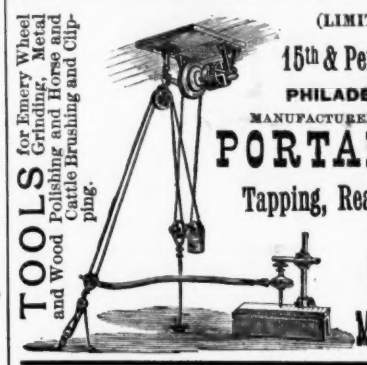

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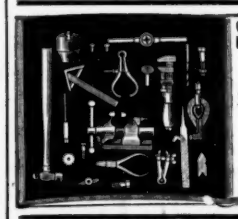

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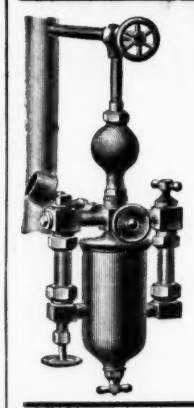

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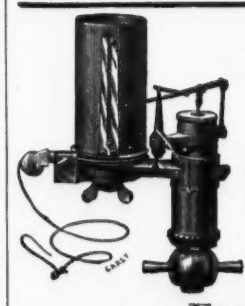

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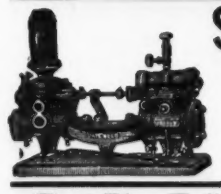

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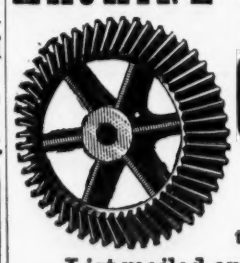

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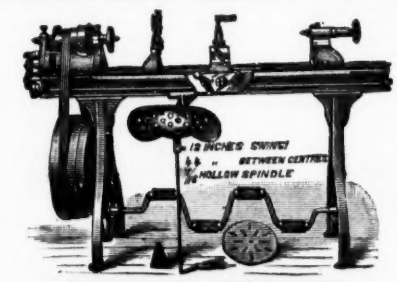

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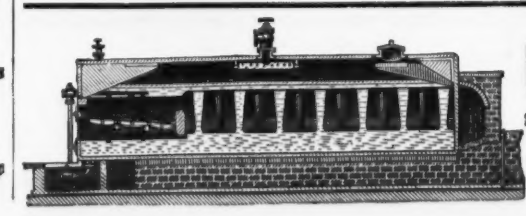

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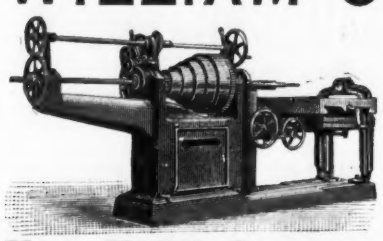

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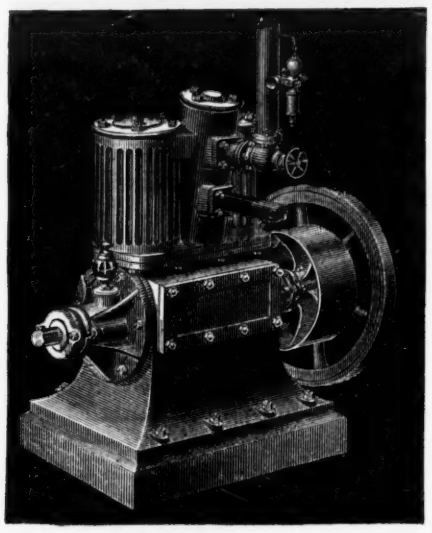

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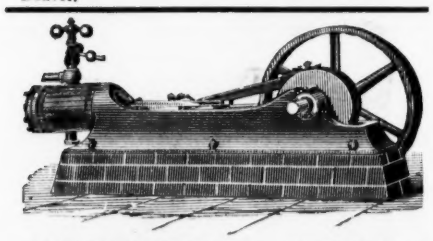

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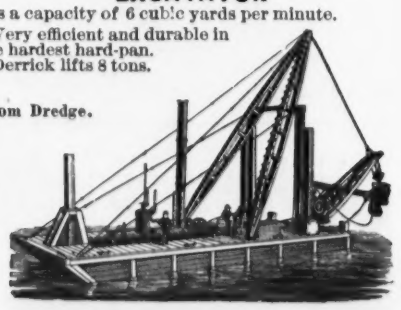

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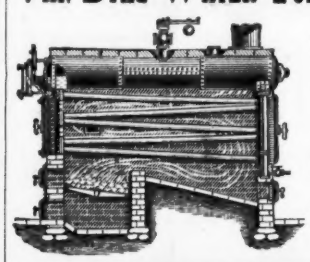

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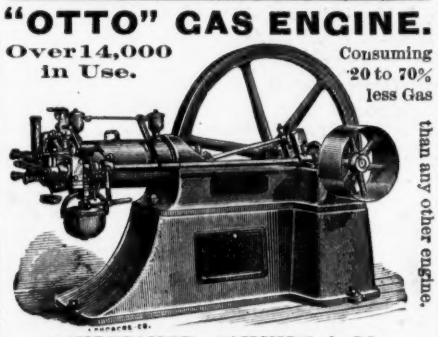

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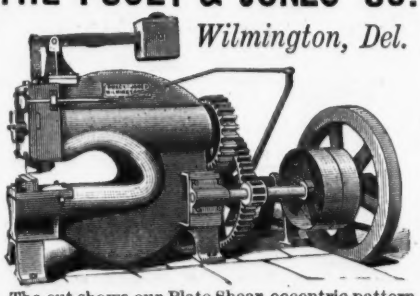

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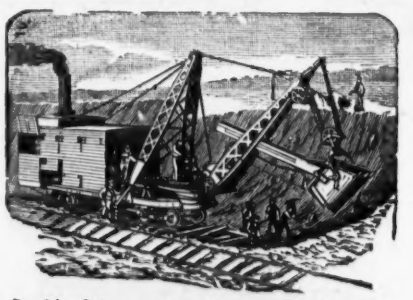

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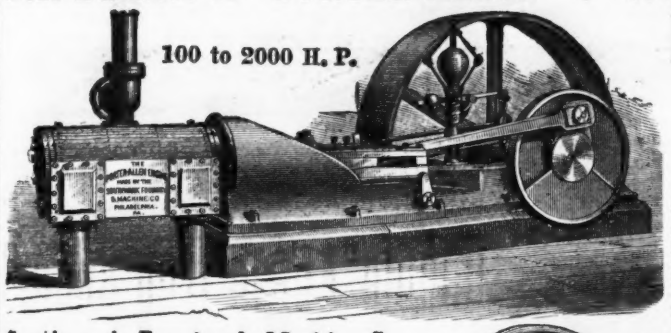

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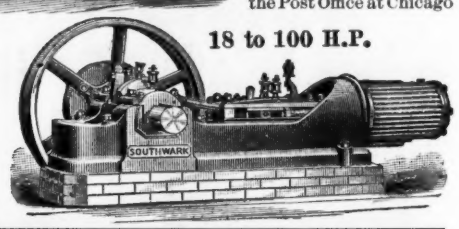
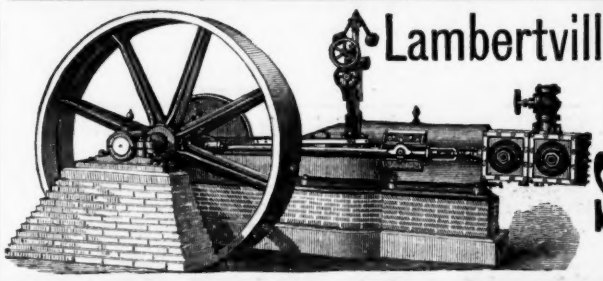


Lambertville Iron Works,



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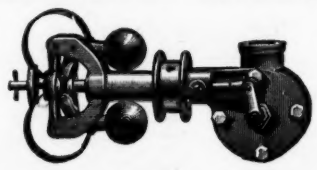

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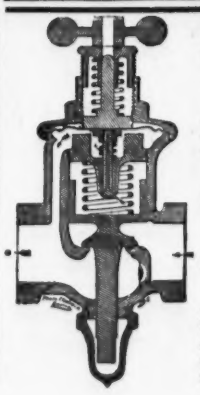

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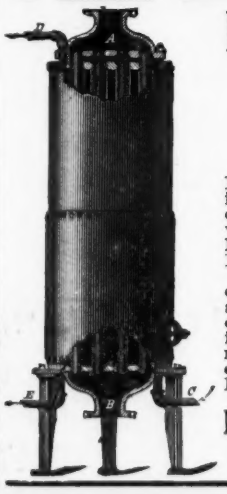

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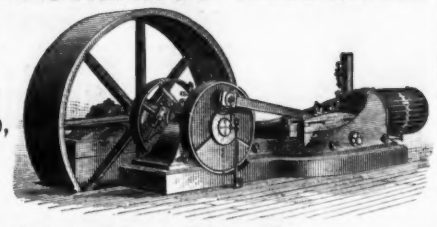

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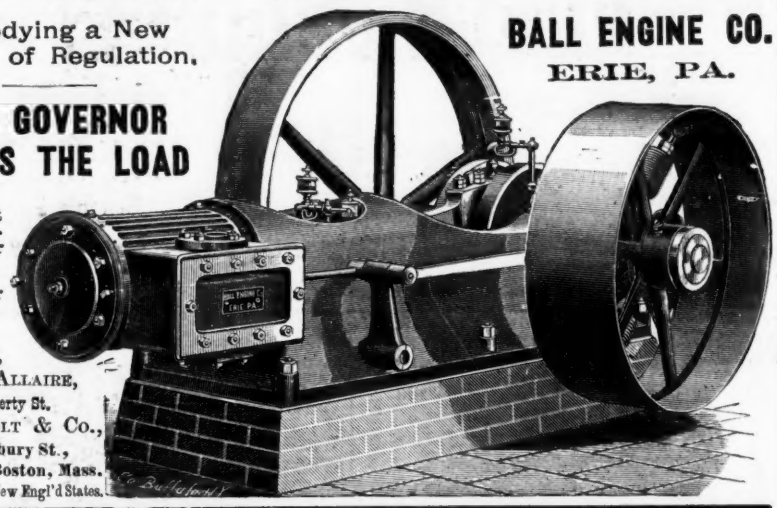

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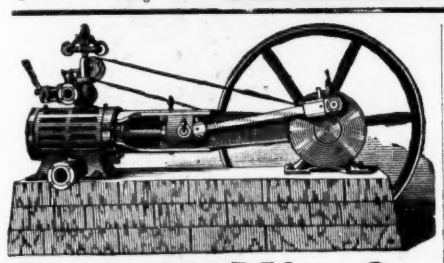

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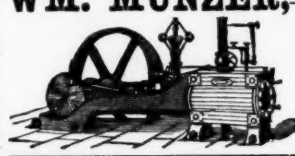

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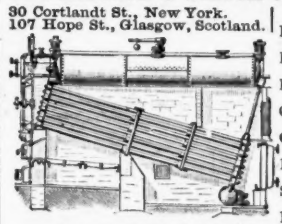

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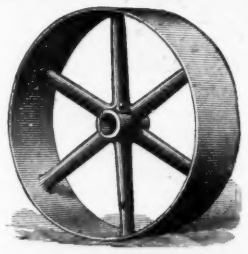

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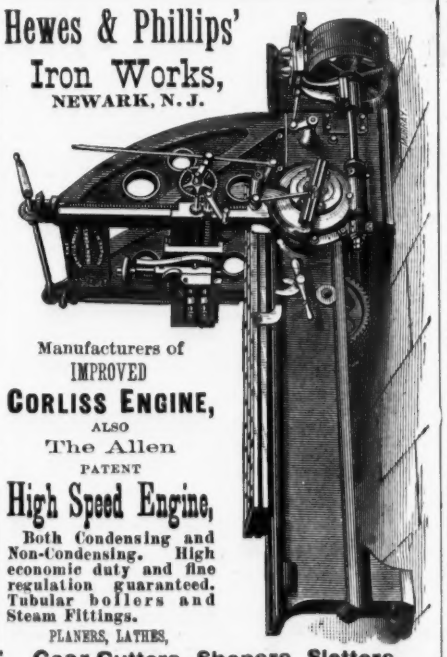

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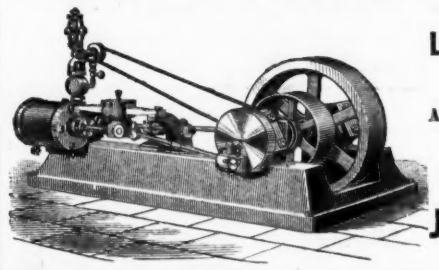

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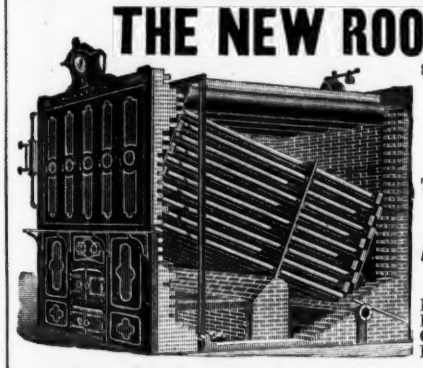

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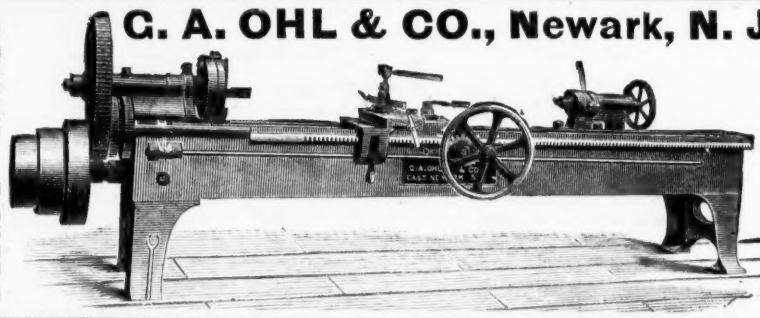

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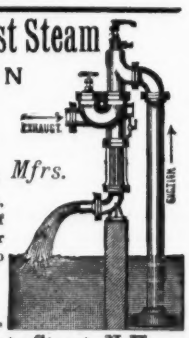

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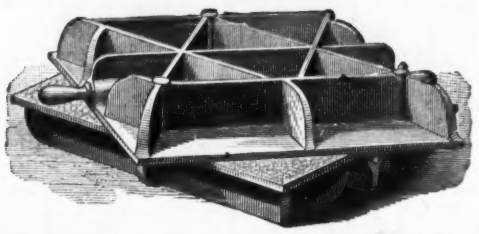

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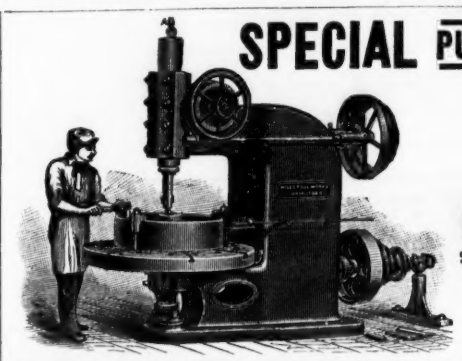

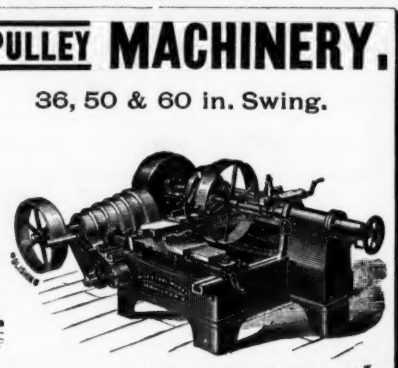

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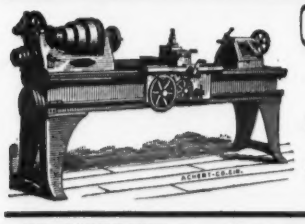

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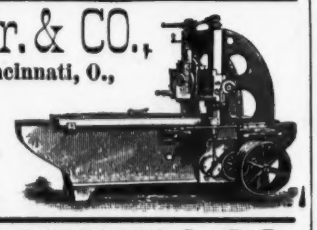

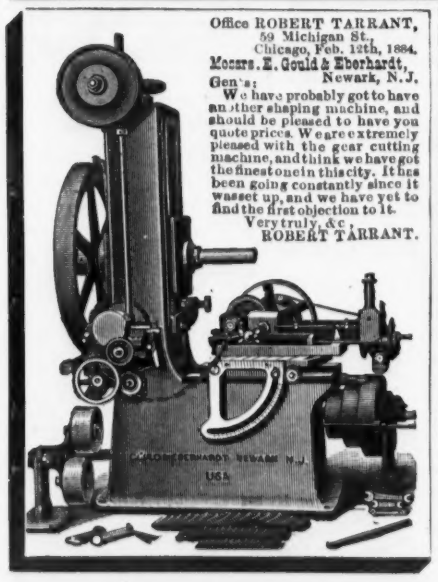

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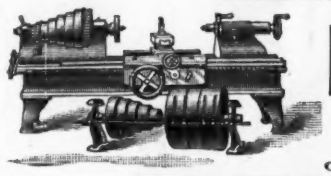

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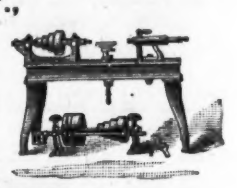

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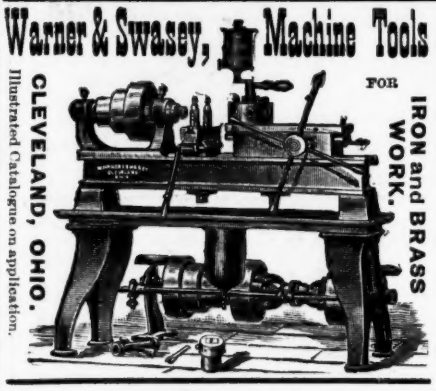

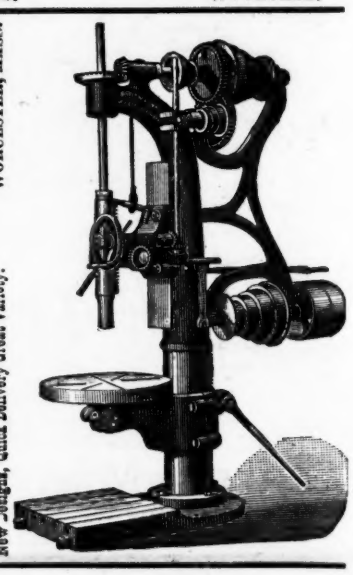

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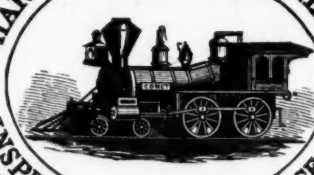

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